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INDIAN FARMING

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THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II JULY 1941 No. 7

THE FIRST CEREAL

OF all food grains, rice is for India the most important. The final estimate of the rice crop for 1940-41 was 72,216,000 acres, yielding 21,850,000 tons, the figures for the previous year (1939-40) were 75,255,000 acres and 25,800,000 tons. The average of the preceding five years was 72,863,000 acres and 25,744,000 tons. The 1940-41 production was therefore 15·3 per cent less than that of 1939-40 and 15·1 per cent less than the average of the previous five years. A chart published by the Director-General of Commercial Intelligence and Statistics, India, on 28 February 1941, giving the annual figures for area and yield during the last ten years shows a gradual decline in the *yield* of rice from 1931-32 up till 1935-36, a recovery in 1936-37, followed by another gradual decline in 1937-38 and 1938-39, with a partial recovery in 1939-40 and followed by the low yield of 1940-41. The *acreage* curve is not parallel to the yield curve over this period.

India has never produced enough rice to feed herself and has relied on importation from Burma which in recent years has varied from 1,198,000 tons rice plus 36,000 tons paddy (rice in the husk) in 1937-38, to 1,887,000 tons of rice plus 339,000 tons paddy in 1939-40. A writer in *Capital*, 8 May 1941, considers that this country's requirements of rice may be placed at 28 million tons annually. From this he draws the conclusions that on the basis of the 1940-41 crop there is a gap of about six million tons between India's needs and resources and that Indian production of rice must be increased by all available means. We may add that the need for this is emphasized by the world rice situation, which, however, cannot be dealt with here.

At the Rice Committee of the Imperial Council of Agricultural Research held at New Delhi on 15 April 1941, much attention was given to this subject and the unanimous opinion of the Committee was embodied in the following resolution :

'The Committee recommends that the attention of provincial and state Governments should be invited to the figures of acreage and production of rice of the last ten years and points out that production has, generally speaking, been going down instead of going up and that it is essential to maintain production. It recommends that steps should be taken by provincial and state Governments—

(i) to provide facilities for timely and sufficient irrigation, e.g. through canals, tanks, etc. in areas where such facilities do not exist at present,

(ii) to distribute to cultivators manures, especially oil-cake, at cheap rates on a large scale, the price being recovered after harvest,

(iii) to distribute pure and improved seed on a large scale,

(iv) to encourage the growing, subsequent to paddy, of suitable *rabi* crops like gram and other pulses in paddy lands, and

(v) to induce cultivators to utilize the area released from other crops for rice cultivation as far as possible.

The Committee emphasizes the necessity of irrigation for paddy lands, which it considers to be of paramount importance to

maintain and improve rice production in India and invites the particular attention of provinces and states concerned to this problem.'

At the end of the last war (1918-19) the position as regards food grains, including rice, was serious. A Central Transport and Foodstuffs Board was constituted in 1918 and was divided into two sub-committees, one dealing with animal and mechanical transport and the other with foodstuffs. In its latter capacity, the functions of the Board were to collate information and advise Government as to measures calculated to develop the production of foodstuffs, to encourage local consumption of local products and generally to inculcate economy of resources in all directions. While it was recognized that the real work in connection with these subjects must be done in the provinces, it was thought that the Board would be a means of supplementing provincial activities, passing on information and offering advice. A certain amount of such work was actually carried out, but, later on, the activities of the Board and its successor were concentrated on equitable distribution of available supplies. The Board was replaced by a single executive authority working under the Government of India and designated the Indian Foodstuffs Commissioner. It is not necessary to go in detail into the successful work which was carried out by the Indian Foodstuffs Commissioner and the provincial Directors of Civil Supplies in the distribution of rice and in the control of its price, but it is worth mentioning that—

(1) the export of rice was severely controlled during the greater part of the last war and for some time afterwards, and

(2) in the years 1916-17 and 1917-18 both the rice and the wheat crops were particularly good, being almost the biggest crops on record. (1918-19, however, was a year in which the monsoon failed.)

At the recent Rice Committee attention was drawn (and has also been drawn by the writer in *Capital*) to the general (though not steady) decline of total rice yield in India during the last ten years and the question has been asked how this could happen in view of the fact that the Agricultural Departments have been turning out numbers of improved varieties most of which give greater yields than those which they were replacing.

There are two observations to be made:

(1) Even if the whole rice area in India were covered with improved rice varieties giving, on an average, an additional 10 per cent yield, the vagaries of the season could easily either wipe out this advantage and turn it into a minus figure or greatly increase it. If we take Canada (where there are enormous areas under improved wheats) and study the annual wheat production figures from 1923 to 1938 (as given in *The World Wheat Production in 1938-39*, published by the International Institute of Agriculture, Rome) we find the yield 474,199,000 bushels in 1923, 262,097,000 in 1924, 566,726,000 in 1928, 180,210,000 in 1937, and 350,010,000 in 1938. The yield *per acre* in these years varied from 7·1 bushels in 1937 to 23·5 bushels in 1928.

(2) Very far from the whole rice area in India being covered by the improved varieties, it is estimated by the Agricultural Marketing Adviser in his *Report on the Marketing of Rice in India and Burma* (about to be released) that only about 6 per cent of the total acreage under rice in India is under improved varieties. It is obvious that efforts are necessary to ensure that larger quantities of seed of improved rice varieties are made readily available and that the multiplication of such seed is properly organized. The organization of seed distribution is no new thing. Leaving out sugarcane, in which crop for special reasons about 75 per cent of the total area is under improved strains, success in seed distribution schemes has been probably most noticeable and widespread in the case of cotton. The Indian Central Cotton Committee has for many years subsidized such schemes as part of its policy.

Most seed schemes have a sort of general resemblance and consist of at least the following stages:

(1) the plant-breeder's plot,

(2) the Government farm where the produce of the plant-breeder's plot is multiplied,

(3) farms of registered growers where the production of the Government farm is multiplied.

(There may be two or even three stages of multiplication carried out by registered growers.)

(4) Final distribution to the public.

In connection with the later stages such schemes require expenditure mainly under the following heads :

(1) 'Roguing' (i.e. purifying the crop in the fields of the registered growers).

(2) The purchase or otherwise obtaining of the crop from the registered growers, perhaps at a premium.

(3) Packing, labelling and transport.

(4) Profit to growers who are pledged to distribute the pure seed.

There may be any number of modifications of this general pattern. In some cases it has been found more suitable to arrange for the return of a multiple of the given seed of the improved crop rather than to buy it back from a registered grower. The main object is to arrange for an even steady flow of good seed to the final cultivators in the scheme and to ensure that the circle of these final cultivators steadily expands to the feasible limits of the scheme. It is obvious that any single scheme of this kind must have limits and hence it is necessary to have various nuclei from which circles of distribution can spread out and finally meet.

Apart from improved seed the other two main requirements for ensuring enhanced yield of rice are water and manuring. At the Rice Committee some members were very insistent on the need for provincial Governments providing greater facilities for the supply of water to rice cultivation. As regards the manuring of rice, the practices vary a great deal in different places, and are largely determined by the nature and amount of manure available. Experimentation on rice manuring as far as it has gone in India has recently been summarized in *Miscellaneous Bulletin* No. 38 of the Imperial Council of Agricultural Research by R. L. Sethi entitled *Manuring of Paddy*. What is now required is to make available, in as great quantities as possible, suitable local or easily available manures for the enhancement of yield. In its resolution the Rice Committee has drawn attention to the possibility of utilizing groundnut cake in this respect. Green manuring of one sort or another, either by growing a green manuring crop *in situ* or by the burying of green matter brought from a neighbouring jungle, appears in many cases to be the cheapest form of manuring, but we are, as a matter of fact, not sufficiently well-informed regarding the economics of rice-manuring. It seems probable that if the prices of rice remain at a level of Rs. 4 a maund, it will pay to manure with groundnut cake at the rate of Rs. 1-8 a maund. Attention is again drawn to Dr Wrench's article in the June issue of this journal dealing with the composting of town refuse and its use to increase yields as a war measure.

W. L. DAVIES

PH.D., D.SC., F.I.C., N.D.A.

An Appreciation

IT was with very great regret that we heard of the death of Dr W. L. Davies, Director of Dairy Research in India, at the Hindu Rao Hospital, Delhi, on 15 May 1941. He was admitted into hospital on Sunday, 11 May, suffering from dysentery, from a serious attack of which complaint he had recovered only a few months previously. Subsequently diabetic coma supervened, and in spite of the best medical attention he succumbed no the following Thursday. He leaves behind in England a wife and two children

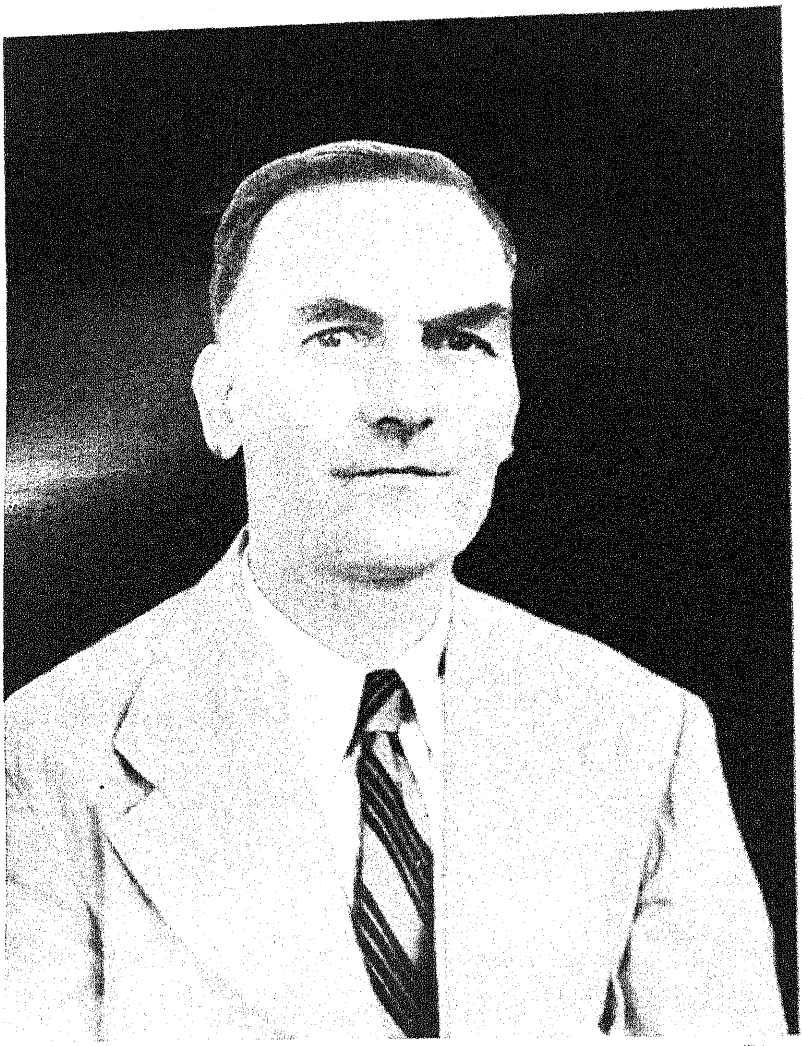
a daughter aged 17 and a son aged 14, for whom the greatest sympathy will be felt by all his friends in India.

Dr William Lewis Davies, Ph.D., D.Sc., F.I.C., N.D.A., was born on 23 February 1896, at Llansawel, Carmarthenshire, Wales. He was educated at Llandilo County School, Carmarthenshire (1908-13) where he obtained the Senior Certificate with Honours of the Central Welsh Board, and at Clark's College, Swansea and London (1913-14). Between 1915 and 1919 he was on military service with the Royal Horse Artillery, and on being demobilized he returned to his studies at the University College of Wales, Aberystwyth, where he took his B.Sc., and later the National Diploma in Agriculture (1921) and became an Associate of the Institute of Chemistry in 1922. He was then awarded a Ministry of Agriculture Research Scholarship to Gonville and Caius College, Cambridge (1922-24) and was awarded the Doctorate of Philosophy (Cambridge) in 1925 for work on proteins and soils. In 1924 he obtained the degree of M.Sc. (Wales), in 1927 he became a F.I.C., and in 1935 he was awarded the D.Sc. (Wales). From 1924 to 1927 he was employed in the University of Reading as Advisory Agricultural Chemist to the Southern Advisory Province and in 1927 he was appointed as Dairy Chemist in the National Institute for Research in Dairying, Shinfield, Reading, where *inter alia* he studied problems relating to the transportation of butter and cheese and the causes of deterioration during the storage of these products.

In 1939 he was selected by the Government of India for appointment as Director of Dairy Research, and he commenced his duties in India on 13 July 1939. One of his first duties was to formulate proposals for the establishment of an Imperial Dairy Research Institute in accordance with the recommendations in Dr Wright's report on the dairying industry in India and while searching for a site for this Institute he undertook some extensive tours and gained considerable knowledge of local dairying conditions. He quickly made use of this information and in 1940 produced a brochure on *Indian Indigenous Milk Products* which will prove of great use to students and others interested in the Indian dairying industry.

The war unfortunately interfered greatly with the proposal to build a new Dairy Research Institute, and Dr Davies had perforce to make use of existing institutions at Bangalore and New Delhi for the introduction of research work on pressing problems connected with ghee, milk and butter. In addition he had recently taken over the advisory work connected with these products, as well as casein and dried milk. In the short time he was in India he had also found time to act as examiner in the Universities of Nagpur, Bombay, Allahabad and Madras and also for the Indian Diploma in Dairying, and his contributions included articles on (1) Colloid aspects of milk technology, (2) Deterioration of butter during storage, (3) The conservation of grass, and (4) The anti-oxygenic effect of cereal flour paste as a coating on contact wrappers for fatty foods.

The dairying industry in India has suffered a very severe loss with the sudden passing at the zenith of his career of such a distinguished officer as Dr Davies. His enthusiasm for his subject and his forcefulness in debate will be long remembered by those who worked with him in committee, and his place, particularly under present conditions, will be very difficult to fill. [F. W.]

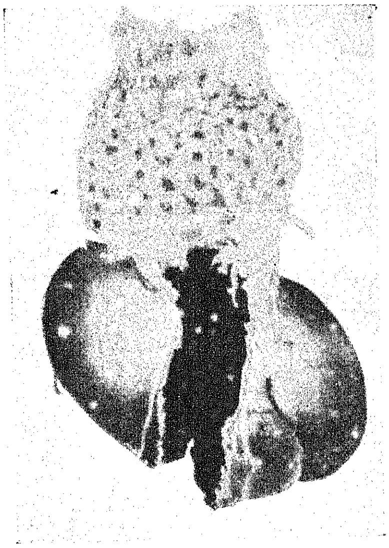


Hindustan Times

W. L. Davies, Ph.D., D.Sc., F.I.C., N.D.A.
Late Director of Dairy Research, New Delhi

PLATE 96

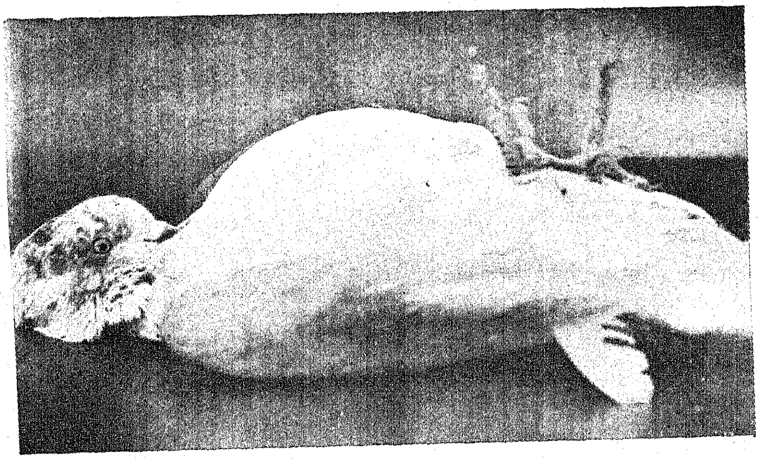
fowl infected with Ranikhet disease virus, showing
:alysis of legs and wings, incoordination of head and
:k and dyspnoea.

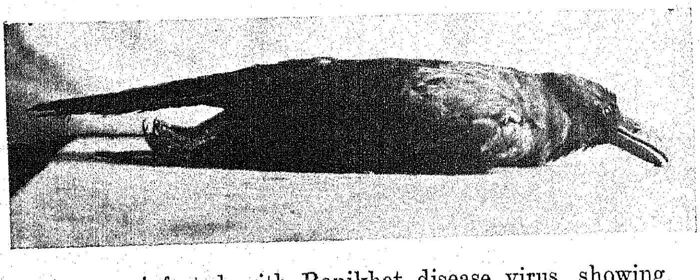


Proventriculus showing ecchymoses
(hæmorrhagic spots)

Left: Cloaca and a portion of caeca showing lesions of catarrhal enteritis.

Below: A pigeon infected with Ranikhet disease virus, showing paralysis of legs and wings.





A crow infected with Ranikhet disease virus, showing paralysis of legs and wings

Original Articles

RANIKHET DISEASE: THE PRESENT POSITION*

By J. R. Haddow, O.B.E., M.R.C.V.S., I.V.S.

Veterinary Research Officer, Imperial Veterinary Research Institute, Mukteswar

In July 1927, a telegram was received by the Imperial Veterinary Research Institute from the owner of a farm of 600 imported English White Leghorn fowls in Ranikhet (United Provinces) announcing that 'a mysterious disease' was decimating his poultry. Almost at the same time, a similar affection broke out in Tanjore (Madras Presidency). Before the end of the year, the disease had spread throughout the Kumaon hills and throughout southern India with devastating results, and, within a couple of years, it was being reported from all parts of the country. Today it is regarded as the most virulent of fowl diseases in India because of its great infectivity, its rapid spread and the enormous losses for which it is responsible.

It was soon shown that this disease was identical with one that had broken out suddenly at Newcastle (England) in 1926, thence spreading to eleven other English counties before it was stamped out. There it was given the name of 'Newcastle disease' by Doyle, the original worker on the problem. Here it is proposed to adhere to the name 'Ranikhet disease' by which it is most popularly known in India.

World-wide distribution

In the same year as the English outbreak, a similar disease broke out in Batavia and soon spread throughout the Dutch East Indies, where it was termed 'Pseudo-fowl pest' on account of the similarity of many of its features to those of classic fowl pest or plague. At the same time, Japanese workers reported a new and identical fowl disease from Korea and Lagrange recorded a new disease of poultry in Egypt, which he described as a typical fowl plague. In 1927, similar infections broke out in Ceylon and in the Philippine Islands, where the disease was called 'Avian pest'. In 1931, Australia was similarly afflicted, and in 1933 came the first reports of the appearance of the Korean disease in Japan itself and in Indo-China. It is also of interest to observe that previous to the diagnosis of this disease, several outbreaks of fowl plague were reported from America (1925), where the symptoms described were typical of the disease under review.

Spread in India

In India, Ranikhet disease spread from the original outbreak throughout the United Provinces and even to Delhi in the autumn of 1927. By the spring of 1928, it had reached the Punjab and Bombay. In the autumn of that year a serious outbreak occurred in Garhwal and another in Chittagong. In 1929, it was reported from other parts of Bengal, from the North-West Frontier Province and Burma. It was first recognized in Assam in 1930 and in Bihar and Orissa in 1933. It should, however, be noted that these dates are unreliable, since in India deaths among poultry have been, until very recent years, generally disregarded by the public and it has therefore been difficult to discover exact mortality figures and, moreover, it is possible that, until the identity of Ranikhet disease was fully established and its symptoms had become widely known, cases of the disease may have been reported under the head of fowl cholera, to which it bears a superficial resemblance. Once the disease had been established in any province, the annual mortality from Ranikhet disease, though subject to variations, appears to have remained at a fairly high and constant figure. Assam, however, claims that from 1933 onwards the incidence of the disease has diminished and for the

* Since this article was written the results of experimental work carried out at Weybridge in Great Britain and Mukteswar in India have become available and it appears that the future as regards control of Ranikhet disease prophylactic vaccination may now be viewed with considerable optimism.

last few years it has not been reported from that province at all. In Bombay, the mortality figures have risen from 196 in 1931 to 3,423 in 1936 and to 5,024 in 1939. Bihar reports that at least 10 per cent of all its poultry contract this infection, while so prevalent has the disease remained in South India that in 1931 the Government of Ceylon actually prohibited the importation of poultry from this country.

Obscure origin

The origin of the disease is obscure. It has been suggested that the Ranikhet outbreak was due to the importation of a new batch of birds four months previously from abroad. Though it has since been shown that the existence of 'carriers' of this infection is unlikely and that the incubation period is so short that the disease could not have been caused by infected birds among the new arrivals, it is, however, possible that the causal organism was present on the birds or in their cages. In no country subjected to a sudden outbreak has it been possible to trace the origin of the disease so that the source of infection remains mysterious. It is, however, generally agreed that today this is an Asiatic disease, though the fact that it now appears to be indigenous to this continent may be due simply to the fact that more rigid quarantine regulations are enforced in Europe, America and Australia.

Description of the disease

A complicating factor in the study of this disease is the variability of the symptoms, and it has even been suggested that they may have become modified in course of time. It is, however, definitely known that it is caused by a filter-passing virus of considerable infectivity and that it is characterized by a sudden onset, rapid course and high mortality.

It is said to appear in an acute, a subacute or a chronic form. In acute cases, the disease may take so rapid a course that the bird dies within a few hours without showing any of the symptoms regarded as characteristic of the disease. Generally, however, it takes a less acute form, in which the first symptoms observed are dullness, weakness so pronounced that the bird may be unable to stand except in a crouching position, sleepiness, loss of appetite and increased thirst. These symptoms are quickly followed by a typical long gasping inhalation through the half-open beak. Some observers claim that this respiratory distress is the most constant feature of the disease. In England, however, it was stated to be lacking in 30 per cent of cases, while it has been shown to be frequently absent in artificially infected birds.

In the majority of cases though not always, there is a profuse exudate or discharge of stringy, clear mucus from the beak and nasal cavities, which the bird appears to be making continual efforts to swallow or to emit, by constant shaking of the head and stretching of the neck. If this effort is not successful, the exudate may hang down in threads for several inches. This discharge is generally associated with an offensive odour arising from the decomposition of the crop contents. Occasionally there is a slight watery discharge from the eyes. There is usually an increase in the quantity of droppings, which changes rapidly to profuse diarrhœa. The fæces, the passing of which may cause pain, are yellowish white, watery, frothy and of a particularly nauseating odour. In fat birds the diarrhœa may be stained with blood. The vent is congested and soiled. These symptoms indicate an involvement of the digestive tract, which is shown to be the case on post-mortem examination. Dropsical swellings of the head and neck and a dark colouration of the comb and wattles are observed in 50 per cent of cases.

Original workers in India observed no rise in temperature, though they described as typical a sudden fall in temperature to sub-normal immediately preceding death. Other observers, including several in India, consider that there is a small average rise of 1·9°F., followed by the typical drop. Doyle, on the other hand, states that there is a marked rise, reaching a maximum on the sixth to the seventh day of illness, but again falling abruptly just before death, when the bird lies in a state of coma.

Incubation period

The incubation period is variously described as lasting from 4 to 11 days, 4 to 6 and 3 to

12 days; the average, however, is regarded as about 5 days. The disease in its normal form generally extends from 4 to 7 days, though it may be as short as a few hours in acute cases, and in its chronic form it may last a month.

In a small percentage of cases, the disease runs a chronic course, and in this form nervous symptoms predominate, though these may frequently be observed also in subacute cases. These symptoms take the form of a certain weakness of the joints, progressing to total paralysis. In this later stage, other characteristic symptoms of the disease may be absent. The first signs of the involvement of the central nervous system are a limpiness in the gait or a drooping of the wings, together with abnormal movements of the head. Affected birds appear giddy and turn round in circles, especially when endeavouring to feed. They peck all round a morsel of food, as if their sense of direction were partly lost. At other times, they will stand with their heads bent backwards and when disturbed will wave them in the air with irregular circular motions. Gradually the paralysis may become more complete. The toes will become curved-in and the muscles wasted, so that the bird can no longer stand, but lies on its side or breast. In this condition, it will probably die of general weakness. Others will, however, gradually recover, though the nervous derangement may persist, in the form of 'wry-neck', an unsteady gait, occasional spasms or a squint. Such birds are valueless.

There are diverse opinions regarding the cause of these nervous troubles. Doyle claims to have proved that they are due to the specific virus of the disease, but other workers are inclined to regard them as the sequelae of fever and nerve injury and therefore not justifiably regarded as stages of the disease. In any case, these symptoms are very few in comparison with the number of cases terminating rapidly in death.

Recovered birds are solidly resistant to further attacks. A few survivors may show complete recovery but, as has been previously stated, may continue to evidence a permanent affection of the nervous system, while Picard noted that all recovered birds are sterile.

Natural transmission

Field workers record that outbreaks of Ranikhet disease usually occur a day or two after a bazar (*mandi*) has been held in a district and it is well known that newly purchased birds are a source of very real danger to a healthy flock into which they may be introduced. This bears out the contention that the disease is highly contagious, healthy birds invariably succumbing to infection if placed in contact with affected birds. It is believed, however, that this infection is caused by way of the nose and throat only and that actual contact is not a factor in transmission unless an opportunity is given to inject the virus.

Infection is also caused by the eating of droppings from the mouth or of the discharges, which contaminate the drinking water and feed of healthy birds. Drinking water is perhaps the most important source of infection as sick birds are extremely thirsty and may regurgitate the water they drink or drop saliva in the trough. In the Philippines, it was observed that the incidence of the disease was highest in the dry season, when all the birds are dependent upon one or two drinking troughs or pools, which become highly contaminated by the virus, and that in the rainy season, when fowls can drink at ditches and puddles, many escape the infection or are only slightly affected. This observation does not, however, appear to have been confirmed in India, where the disease is not known to have any particular seasonal incidence, though one worker suggests that it is most virulent from July to January, that is after the outbreak of the monsoon. It is, however, significant to observe that the disinfection of drinking water by a suitable dilution of potassium permanganate is a helpful factor in controlling an outbreak. Philippine workers also claim that the breathing of infected air does not transmit the disease; but this has not been confirmed by experimental work conducted in India.

How infection spreads

The disease is also caused by indirect contact. Attendants have been frequently known to carry infection from sick birds to a healthy batch of fowls some distance away. At

Mukteswar, two laboratory boys, who were in charge of experimentally infected fowls and also possessed small private flocks, had their own flocks wiped out. Runs and houses that have been occupied by affected fowls and soiled by their saliva and droppings are believed to remain infected for one or two months. The same applies to railway vans, which are another dangerous source of indirect infection, healthy birds frequently contracting the disease upon journeys, even when sent in the most modern cages. Carcases of birds that have died of Ranikhet disease may also cause infection and it has even been suggested that outbreaks of the disease can be attributed to modern commercial methods of cold storage preservation, as in the case of foot-and-mouth disease ; for it has been shown that, under trade chilling conditions, the virus of the disease may remain virulent up to six months or even longer.

From some quarters has come the suggestion that lice and ticks play a part in the transmission of this infection but a great deal more work is required before this contention can be confirmed or disproved.

Another source of infection to poultry, the possibilities of which have been indicated by experimental studies, is that of other birds susceptible to the disease. It has frequently been reported that, during outbreaks of Ranikhet disease among fowls, crows have been observed dying in large numbers in the neighbourhood of affected farms. These crows have shown typical symptoms of the disease, particularly the nervous variety, and experimental research has shown them to be susceptible to the fowl virus. It is still, however, by no means certain that they are capable of transmitting the disease to fowls. Several workers, indeed, have been led to believe that the virus undergoes some modification in the body of the crow and ceases to be harmful to poultry. One set of experiments conducted at Mukteswar did, however, appear to indicate that fowls could be infected with the crow virus. If this is the case, the importance of the role played by wild birds in the transmission of the disease cannot be overestimated. One poultry keeper did actually report that shortly before an outbreak of Ranikhet disease, a crow was observed, sitting on the branch of a tree overhanging the run, with mucus dripping from its beak.

It is, nevertheless, evident that our knowledge regarding the transmission of this disease is still very inadequate and that the conduct of proper investigations regarding its spread are of vital importance to the poultry industry.

Experimental

A very large number of experiments have been carried out with a view to increasing our knowledge of Ranikhet disease. These have included research to ascertain the most reliable methods of experimental transmission, the nature of the virus and its distribution in the system, and the means of treatment, prevention and control of the disease. The results of these, all except those included in the last category which will be dealt with presently, are briefly summarized as follows :

(*a*) Intravenous inoculation of liver and spleen emulsion is the most reliable route of infection. Subcutaneous inoculation and the rubbing of swabs of cotton wool containing the mouth exudate of sick birds over the mouth and pharynx of healthy birds are both fairly reliable methods. Scarifications, instillation into the eye and intraperitoneal injections are usually successful. Intramuscular inoculation produces variable results.

(*b*) The virus is contained in the spleen, kidneys, ovaries, testes, liver, lungs, crop, saliva, intestines and brain of sick birds, and is also usually found in the blood and fæces.

(*c*) Preserved virus is alive and virulent up to 197 days. It will remain alive for possibly 11 months in the muscles and bone marrow of carcases kept in cold storage. Under natural conditions, active virus can be recovered from a bird seven days after death. Exposure to direct sunlight for one hour has no lethal effect on the virus. Cotton wool swabs charged with throat material by field workers and transmitted by post are still virulent after a three days' journey.

(*d*) A 1 : 1000 watery solution of potassium permanganate inactivates the virus in 40 minutes. A 1 : 5000 dilution of formalin, also bichloride of mercury, are good antiseptics.

(*e*) The virus can be passaged by inoculations from one fowl to another for many years.

(*f*) The disease is not communicable to mammals. Indian crows, green parrots, pigeons, guinea-fowls and turkeys are susceptible to natural infection, though they show a comparatively greater resistance than fowls. Geese and ducks appear to be highly resistant to natural infection but may succumb to artificial infection.

(*g*) Eggs of infected fowls are infective but chickens from the eggs of resistant or immune fowls do not appear to be immune, though this finding has recently been queried by one worker in India who claims to have shown that resistance to Ranikhet disease is transmitted by hens to their progeny, even when the cock bird is not immune.

(*h*) Ranikhet disease is indistinguishable by certain blood tests from Doyle's disease, Avian pseudo-pest in Java, Philippine avian pest, and the disease in Korea and Japan. It has not been proved, however, to be of the same character as the diseases reported from Australia, Ceylon and Egypt.

Diagnosis

There are a few diseases with which Ranikhet disease might be confused on clinical examination, such as fowl cholera, American infectious bronchitis and fowl plague. It can, however, be distinguished by the following means :

(*a*) from fowl cholera by the examination of the blood ;

(*b*) from American infectious bronchitis by the appearances seen at post-mortem ;

(*c*) from fowl plague it is much more difficult to distinguish. Indeed, many writers are of the opinion that Ranikhet disease 'is identical with fowl pest and only differs in its prolonged course'. In the meantime Doyle's view that the disease he discovered is a separate disease, bearing a superficial resemblance to fowl plague but differing from it in period of incubation, symptoms, lesions and harmfulness for pigeons must be accepted.

The incubation period of fowl plague is usually 24 to 48 hours, whereas in Ranikhet disease it is 5 to 7 days. With regard to the symptoms, Doyle remarks that in his considerable experience of fowl plague, he has never observed the 'gasping for breath through half-closed beak' regarded as characteristic of Ranikhet disease. Nor are nervous symptoms met with in fowl plague. In Ranikhet disease, there is a marked absence of lesions, and haemorrhages are much less extensively found on post-mortem examination than in cases of fowl plague. Fowls made resistant to Ranikhet disease are still susceptible to fowl plague and *vice versa*.

It should, however, be observed that certain workers have recently claimed that the virus of Ranikhet disease can by inoculation be so modified that it produces the same form of disease, with a short incubation period, as fowl plague. In these cases, the clinical symptoms and anatomical findings are the same in both diseases. Other workers have, however, failed to obtain these results and the position, consequently, still remains obscure.

Treatment, prophylaxis and control

Ever since the first diagnosis of Ranikhet disease much study has been devoted to the problems of treating, preventing and controlling this infection, but results, up to the present, have been most disappointing.

It appears that treatment by the use of drugs is valueless. One Indian worker claimed that 2 per cent trypan-blue solution was a useful immunizing agent, but field trials and further experimentation failed to confirm this. Various remedies suggested by laymen have been tried out but have met with no success.

Work on the production of anti-sera and vaccines has been almost equally discouraging. It was, indeed, early shown that the injection of a serum derived from recovered fowls, followed in 24 hours by an infecting dose of the virus could provide a solid immunity, but, when it is considered that 1 to 5 c.c. of the serum is required for the protection of one bird and that 5 c.c. is the maximum amount of serum that can be obtained from a fowl, it will be realized that this method can scarcely be practically and economically adopted as a routine method, save for valuable birds.

Consequently, strenuous efforts have been made to find an animal capable of providing much larger quantities of blood serum, but, unfortunately, ducks, turkeys, donkeys, sheep, goats and bulls have all been shown to be useless as serum makers.

Attention was then turned to the possibility of preparing a vaccine against Ranikhet disease, again with distressingly little result. Various vaccine preparations have been tried. At Mukteswar efforts were first made to produce a vaccine from the organs of diseased fowls on the lines adopted in the Philippines in preparing anti-rinderpest vaccine but no immunity was established. Work on other vaccines though at first thought to promise some success, was later shown to be unsatisfactory. Better results were obtained from efforts to immunize fowls by the inoculation of suitable mixtures of an emulsion of virus-containing tissues and a solution of saponin but a practical standard was not obtained, thereby rendering it useless for field issue.

Attempts to weaken the virus with a view to rendering it suitable for use as a vaccine had no success.

Japanese workers, however, claim that the route of injection of the vaccine has considerable influence upon its immunizing effect, intravenous application giving better results than subcutaneous or intramuscular inoculations. They state that they obtained a 54 per cent success with intravenous injections of formalized vaccine but even here their results were variable, depending upon the particular stock of vaccine used. In India efforts to provide immunization by scarification have been of no avail.

No treatment available

It appears, then, that there is at present no known method of treating or preventing Ranikhet disease. Consequently, the most strict quarantine and sanitary measures must be observed to prevent its outbreak on a farm, or, once the infection is established, to control it. To prevent the introduction of the disease by infected birds from outside, all new stock should be rigidly quarantined for two weeks. Crows should be kept away by cutting down all trees near fowl pens and by regular shootings, for, though there is no definite evidence that they can actually transmit the disease, they are a potent source of danger on account of their scavenging habits. In Australia, where the infection was successfully stamped out, quarantine measures were extended to include pheasants, quails and even parrots.

If, in spite of these precautions, infection does break out, the most economical and safest course in the long run is the immediate eradication of all birds exhibiting symptoms of the disease and the most careful disposal of the carcases. This should at once be followed by the removal of healthy fowls from infected pens and, where possible, the division of the flock into small isolated groups. Infected houses and runs should be rigorously disinfected, and, if feasible, left unused for two months, while the food and water of all non-affected birds in the neighbourhood should be regularly disinfected by the addition of potassium permanganate.

It is recognized that these measures are only possible in well-equipped poultry yards, but they have been, on every occasion when they have been adopted, successful in restricting the disease to a few birds. As the Indian poultry keeper comes to realize the value of proper management in this industry, it is hoped that, even should science fail to discover a remedy or preventive agent for this disease, it will be possible to eradicate it from India by measures such as those described above, even as it has been eradicated from England and Australia. Meantime, there is still much work to be done in elucidating the problems of transmission and of the nature of the virus, and in further attempts at serum and vaccine production. The value of a systematic study of this disease cannot be overestimated, for until it can be brought under control, poultry keeping in India cannot take its rightful place as a profitable side-line of agriculture and industry.

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PADDY GROWING IN COORG

By A. C. Thimiah, M.A. (Cantab.)
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FOR the paddy cultivator the agricultural season starts on the outbreak of the first rains immediately preceding the monsoon, but its logical start may be traced to the end of the agricultural operations in the first week of February. February heralds the beginning of the hot weather which, but for a small break in March, will last till June—the end of May if the gods are propitious. The prudent cultivator analyses his takings in the light of the impending season. He has to face four hard months when water is scarce in a land devoid of irrigation, when fodder is of the poorest and cattle are doubtful cases between disease and starvation. Rain expected in March comes at the end of April; his emaciated cattle fall an easy prey to disease; his manure deteriorates; and even his health is menaced by an inadequate supply of good water for domestic use.

Having managed to struggle through the first three months, the cultivator prepares, at the beginning of May, for the imminent season. He looks over his cattle, which if still alive may be quite unserviceable. Tenant cultivators borrow the money to purchase fresh plough cattle from their landlords if necessary.

Disappointing animals

Plough cattle are the most vital factor in the agricultural system. These cattle are normally imported and consist at most times of diseased and ill-conditioned animals that neighbours have rejected. The few animals that are good are priced exorbitantly. To the single weekly market buyers may travel as much as 50 miles to and fro; and rather than repeat the journey and the disappointment they will purchase what is available. Prices are increased by the habit of local buyers cornering the best animals for resale. Reluctantly, the ryot will pay out his money and drive home his pair. The skin and bone he has bought may have cost him between Rs. 20 and 30; but he hopes to put them into shape before the monsoon breaks. His chances are fair unless disease intervenes. In the absence of any veterinary examination before purchase, there is a possibility—in times of distress amounting to a certainty—that these imported cattle are diseased. A good pair of animals costing about Rs. 50 may last with care about eight seasons; a bad pair, besides failing within the season, may leave a legacy of disease to the local animals.

Government has tried to improve the livestock by presenting valuable stud bulls for local purposes to well-established farmers; but experience has shown that very few of the ryots have availed themselves of this facility. The reason is hard to find; but it may be traced to a psychological fear whether anyone will look after their cattle as well as they do even for the limited time when they are sent for covering. They may also reflect on the fact that few of the people who have had the services of these Government animals have been able to improve their stock. The cow itself may be already diseased; and even otherwise the calf has diminished chances when it mixes with animals which are already diseased. Improvement of livestock is only possible when steps are taken to prevent further deterioration.

Best manure

Cattle manure is the finest fertilizer for paddy cultivation. Mixtures of artificial manures such as sulphate of ammonia, superphosphate and niciphos give large yields but result in far too rapid soil deterioration. These manures are beyond the means of the ryot. Eight cartloads of cattle manure augmented with green leaf are sufficient to maintain the fertility of one acre of land.

According to necessity the cultivator may plough from three to six hours daily, starting from 6 a.m., and in an emergency ploughing till 12 noon (with a half-hour break at 9 a.m.). The afternoons are used to clear *bunds* and drains and to repair the ravages of crabs and rats.

I have tried various ploughs, but I find the old wooden plough with the metal shaft most satisfactory. A motor plough, which I have experimented with, besides being unusable in heavy slush, was not satisfactory. The iron plough is too heavy for the cattle, though it is superior to the wooden plough. Where fodder is scarce and of poor quality, only medium-sized animals can be maintained and these, however sturdy they might be, cannot bear the weight of the iron plough continuously. Good results can be obtained with the normal wooden plough. For the success of the operation lies far more in seeing that the field is ploughed completely with overlapping furrows than in insisting on the technical excellence of the machine. The fields are ploughed five or six times till the mud is running pulp. Seed is left in a nursery to germinate from 21 to 40 days—varying with altitude, manure and quality of soil. Each cultivator keeps his own seed, while prudent landlords supply their tenants with seed.

Better price for clean paddy

Before transplanting, the fields must be clean. All traces of weed must be removed, *bunds* repaired, drains cleared. Steps must constantly be taken to prevent either water stagnation or water scarcity. The seed takes 3½ to 5 months to yield. When the time for harvesting arrives the water from the fields is drained out and the paddy is cut.

After it is allowed to dry in the fields for two or three days the paddy is stacked. Bit by bit the paddy is threshed and the straw trodden over by cattle. The straw is then removed and the paddy cleaned. I find the winnowing machine most useful for cleaning paddy and removing all foreign matter. Well cleaned paddy has always a better market value.

The cultivator has now to face the problem of marketing. Tenants do not normally come within this problem. They pay the landlord in kind and the surplus covers their normal expenses. If there is still anything to spare, it will be disposed of locally. Large-scale tenancies are rare.

Owners are helped by grain societies, but the mistake made is in being content to control conditions locally. For example, the ultimate market for Coorg paddy is on the Malabar coast; and it is here that the societies are handicapped. Belief in their own powers makes them dispense with commission agents; false economy makes them dispense with warehouses; cost of transport (by motor) to the market is heavy and merchants there know that once the paddy is on their doorstep it will be sold to them quickly. The experience of our family for over 25 years has made me trust in a reliable commission agent to get the best value for my produce.

Landlord and tenant

Most of the cultivation is carried on personally by the owner and his family. This method is successful where holdings are small. Cultivation by means of coolies is successful where the owner puts in continuous personal supervision. Tenant cultivation, though workable, is seldom a glowing success. Either the tenants try to squeeze as much as possible out of their landlord (to whom they are often heavily indebted) in the shape of help, and having thus more or less hypothecated the crop, give the land the minimum of attention; or else the landlord insists on his rights but leaves the tenants to shift as well as they can.

The problem of indebtedness and its palliative—cooperation—has come in for close scrutiny. At present we seem to be perched perilously between the Scylla of a moneylender's debt and the Charybdis of improvident borrowing from a cooperative society. It is generally felt that no society should be encouraged to lend money to an agriculturist until it knows his existing commitments.

How paddy pays

Paddy cultivation is a sound commercial proposition in most times, even during depression. I have found it to pay.

The expenses on 50 acres of fairly good land total Rs. 1,900—i.e. Rs. 38 per acre. This includes provision for depreciation on

implements and livestock at 20 per cent and eight cartloads of cattle manure per acre at Rs. 16 delivered on the land.

The normal return is 1,200 *butties* of paddy, i.e. 80 cartloads. Normal prices are Rs. 3 per *butty* (80 seers), thus giving a net profit of Rs. 1,700. Even when prices reached their lowest (Rs. 2 per *butty*) there was a small margin of profit, assuming that the yield was still the average. Present prices would put the profits still higher.

Agriculture is a stable industry. Dividends are seldom spectacular but a net loss is improbable. It needs hard work, close supervision and a belief in the productive capacity of the earth.

SCIENCE TONES UP CULTURE

IT may be argued that one of the reasons why men have been willing to accept conclusions derived from science in place of older ideas has been their serviceability in some aspect of culture or industry. On this ground we might well hold that the kind of serviceability which is capable of generating the highest esteem for science is serviceability for social welfare. The development of economic and agricultural policy in post-war Europe to secure the maximum utilization of scientific knowledge of nutrition might be an important factor of this type in one special field.

The influence of science upon both means and ends is not exercised directly upon individuals but indirectly through incorporation within culture. Moreover, science is not simply a body of conclusions. Even more important from a cultural point of view, science is an attitude of mind which resolutely employs certain methods of observation, reflection and test. Scientific inquiry indeed has a morale of its own, including willingness to hold belief in suspense ; ability to doubt until evidence is obtained ; willingness to proceed on evidence rather than on a personal preference ; ability to hold ideas in solution and use them as hypotheses to be tested instead of as dogmas to be asserted ; and the enjoyment of new fields for inquiry and of new problems.—' Cultural Significance of Scientific Method ' *Nature*, 28 December 1940.

TINNED MILK

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THE amount of tinned milk imported annually into India before the present war was about 200,000 cwt., representing a milk equivalent of roughly 700,000 maunds (5½ million gallons) or the equivalent of 0·1 per cent of the total milk production of India. The retail price of such milk is very high compared with that of the milk equivalent of the contents of a tin as liquid milk. Thus a 10 oz. tin was sold at roughly 14 as. (pre-war). Such a tin contained the equivalent of 24 oz. of milk, of 3·6 per cent of fat and 8·8 per cent of solids not fat. Such milk therefore was being sold at 0·88 seers to the rupee as against raw milk at 4 to 6 seers to the rupee. It can be realized at once that the manufacture of condensed milk in parts of India where milk is plentiful, so as to replace most of the imported condensed product, would be a proposition worthy of consideration.

Types of condensed milk

There are two types of condensed milk—sweetened and unsweetened. For the manufacture of these two types either whole or skim milk can be used. The unsweetened product is usually termed *evaporated* milk; very little unsweetened condensed skim milk is made. Some condensed whey and buttermilk are also manufactured.

The condensed product from whole milk has what is termed a 'concentration ratio' of 2·4, i.e. 2·4 lb. of raw milk are needed to make 1 lb. of the condensed product, containing not less than 9 per cent of fat and 31 per cent of milk solids. The sweetened condensed skim milk has a concentration ratio of about 3 and must contain at least 26 per cent of milk solids not fat. The unsweetened condensed skim milk must contain at least 20 per cent of solids not fat. These are the standards of composition set for these milk products intended for importation into India and are the same as those in force in the British Isles. The cane sugar content of the condensed whole milk product is about 42 and of the skim milk product, 45 per cent.

The United States Federal standards are lower than the above. Previous to July 1940 the minimum standards for evaporated whole milk were 8 per cent fat and 28 per cent total milk solids. Since March 1941, after a short term at 7·8 and 25·5, the standards are now fixed at 7·9 and 25·9 per cent respectively, or at a concentration ratio of roughly 2·1—2·2.

The label on the tin must describe the condensed milk fully, and the liquid milk equivalent in terms of milk of 3·6 per cent fat and 12·4 per cent of milk solids has to be given on the label. In the case of condensed skim milk labelling, the liquid skim milk means milk containing 9 per cent of milk solids other than milk fat. Owing to the very low fat content, condensed skim milk must also be labelled as *unfit for babies*.

Food value

Condensed milk, especially the sweetened type, is a valuable concentrated food. The composition of various tinned foods in descending order of caloric value per unit weight are given in the following table.

Tinned Product	Protein	Fat	Carbohydrate	Calories per 100 gm.
Condensed whole milk, sweetened	8·3	9·1	54·1	331
Corned beef	15·6	26·2	..	298
Condensed skim milk, sweetened	9·7	0·3	59·3	286
Tinned salmon	21·8	12·1	..	196
Whole milk evaporated	8·3	9·1	12·1	168
Tinned pineapple	0·4	0·7	36·4	154
Tinned peas	3·6	0·2	8·6	51
Tinned tomatoes	1·2	0·2	3·5	21

In addition to the constituents given above for the milk products, the vitamin content

of milk (A, B_1 and B_2, C and D), the availability and the balance of the minerals and the high biological value of the proteins have to be considered. The low caloric value of tinned fruits and vegetables may be pointed out.

Other condensed milk products

Some whole, partly skimmed or skim milk is condensed to three or four times its original concentration to give 'plain condensed milk' which is not sterilized but consumed within a short time of manufacture. Buttermilk is concentrated three to four times to give semi-solid or condensed buttermilk of 27 to 29 per cent solids. Condensed whey or primost is made by concentration of the solids about 15 times in a vacuum pan, the product crystallizing out into blocks on cooling.

Manufacture of condensed milks

Milk is condensed and tinned with the intention of long storage without spoiling. Two problems therefore arise, namely (*a*) the most economic method to evaporate the water necessary to give the desired concentration of milk solids, and (*b*) the treatment of the condensed product to preclude the growth of micro-organisms during storage. Minor problems are connected with methods of preventing butterfat from churning out in the whole milk products and the maintenance of the right thickness or viscosity of the sweetened product so that the product flows easily out of the tin in use.

The damage done to the physical properties of milk and to its nutritive value by the prolonged boiling of milk at its natural boiling temperature precludes boiling at 100°C. as a method of concentration. A far better product with less consumption of heat per lb. of water evaporated is given by vacuum evaporation at 125 to 135°F. The process is carried out in a vacuum pan suitably designed to avoid loss of milk by entrainment, where controlled heating of the milk by means of steam coils is possible and where the maintenance of a vacuum and condensation of vapour is effected, in the case of large capacity pans, by a falling column of water. Owing to the relatively small amount of concentration needed, a simple evaporator only is used in milk work as against the multiple effect evaporators used in the high concentration of dilute sugar juices.

The vacuum pan

The pan is an egg-shaped vessel standing on end, supplied with a nest of steam coils inside the base, a manhole and an inspection window in the upper half and a wide swan-neck delivery pipe at its apex which connects with the condenser-vacuum column. The rate of boiling of milk is controlled by the rate of steam flow in the coils and initial foaming can be controlled by a small vacuum breaking device. A fresh batch of milk after initial frothing quietens down quickly to regular boiling.

Treatment of milk before evaporation

(*a*) *Standardization of composition.*—The fat : solids not fat ratio in the product is 9 : 22 (or 1 : 2·44). In order to obtain this ratio in the raw milk and in order to facilitate the control of the degree of concentration reached later, the liquid milk has to be standardized to this ratio. This is done as the first step in the handling of the milk by determining the fat and solids not fat content and adjusting by the addition of cream of known fat content or of skim milk, whichever is necessary.

(*b*) *Heat treatment of milk.*—In making condensed milk, the treatment of the raw milk is important from the point of view of the quality and behaviour of the finished product and there are properties of the product which are influenced by the treatment given to the milk. The two most important properties, sterility, and thickening of sweetened condensed milk with length of period of storage, are controlled by the heat treatment of the raw milk. This is done by the process known as heat-shocking the milk, in which the liquid is momentarily heated to 190° to 200°F. ; and then cooled to 130°F. (by cooler or heat-exchange) before being drawn into the vacuum pan.

(*c*) *Addition of sugar : Homogenization.*—For sweetened condensed milk the hot milk is made to dissolve the required amount of

sugar as it cools, whilst for the unsweetened type the milk fat is homogenized at about 150 to 160°F. The process of homogenization avoids the trouble of churning out of butterfat during the handling of the tins subsequently and avoids losses due to the heat clotting in the sterilization process (at 240°F.) which usually occur with the product from non-homogenized whole milk. To prevent the formation of butter in non-homogenized milk it was necessary to raise the sterilization temperature to that where the product coagulated to a thin jelly, which broke up to a fluid on shaking the tin; it was troublesome to find the right conditions for this purpose since pilot tests had to be carried out after the addition of alkali stabilizers. Homogenization of the original milk has facilated manufacture greatly and given less spoiling of product.

The problem of *thickening* of sweetened condensed milk with keeping (so that the viscous liquid would not flow out of the tin) can be avoided by the heat-shocking process which has the effect of accelerating the attainment of equilibrium in the inorganic colloidal milk constituents, especially the calcium phosphate—caseinate fraction.

Control of the evaporation process

As mentioned above, the sugar in the manufacture of the sweetened product is dissolved in the hot milk. The sugar is likely to introduce organisms into the milk which will shorten the storage period of the condensed product so that heat treatment is necessary. The sugar is therefore added to the hot liquid milk and not to condensed milk, owing to the possibility of contamination mostly with yeasts, moulds and proteolytic organisms, and to the ease of handling the sweetened condensed product.

The hot milk is drawn into the pan by vacuum until the steam coils are covered; the vacuum is increased until the milk boils gently. After a preliminary frothing or foaming, the milk settles down to boil quietly. More milk is slowly drawn into the pan to keep the coils covered. After considerable concentration the temperature of the steam in the coils is slowly raised to maintain a uniform rate of boiling. By experience, using milk of known volume and composition, the pan operator has a good idea when the batch is ready from the level of the concentrate in the pan. At this time, a sample is taken for a rapid determination of its solids content (either by a hydrometer or a viscometer) and condensing is then continued or stopped according to the results of the test. When ready the batch is then 'struck'. The pan contents are emptied into a drop tank, the pan being at once used for the next batch (or drained previous to cleaning).

It must be realized that the preparation of the sweetened product requires more evaporation of water than the unsweetened product. For evaporated milk 1,000 lb. of raw milk will give 420 lb. of product and require 580 lb. of water to be evaporated. In making the sweetened product, 1,000 lb. of milk plus 176 lb. of sugar (total 1,176 lb.) will give 420 lb. of product and require 756 lb. of water to be evaporated, i.e. an additional 30 per cent of water to be evaporated from a much more concentrated solution. It is obvious that more steam is required to produce sweetened condensed milk than the unsweetened product.

Treatment of the concentrated milk

The unsweetened concentrate is filled at once into tins which are sealed immediately. The contents are then subjected to sterilization in autoclaves, either in batches for small numbers or by a continuous process for the modern treatment of large outputs. The temperature of sterilization is about 240°F. and the heat treatment is carried on for 20 minutes. Too high a temperature may cause heat clotting of the condensed milk and a browning of the colour due to caramelization. A small amount of stabilizer (sodium citrate, phosphate or bicarbonate—2-4 oz. per 1,000 lb.) may be added to prevent clotting. The tins are cooled and kept in store until box-packed. Sample tins from all batches are kept as control for two to three weeks during which faults due to incomplete sterilization will be manifest. The sterilization process is the key process defining the keeping qualities of the product.

As the sweetened concentrated product is cooled the lactose will be in supersaturated solution; there will be 12 parts of lactose to

28 parts of water (30 per cent solution) while at room temperature a saturated solution of lactose contains only 16 per cent of sugar. Lactose must therefore crystallize out and if allowed to do so at ordinary storage temperature will do so as large hard crystals which will deposit at the bottom of the tin giving rise to the fault known as 'sandiness'. The formation of large crystals is overcome by making the crystals form as a large number of small ones at 30°C. by stirring the product after the addition of either some lactose powder or some of previously crystallized batches of condensed milk. This is termed the process of 'forced crystallization', and whereas this used to be done previously in batches in cans fitted with paddles, the process can now be carried out by a continuous method. The product is then ready for canning. The sterility of the product is maintained by the high concentration of sugar; this is over 62 per cent in the whole milk, and 66 per cent in the skim milk product.

Faults in condensed milks

Faults in condensed products are either those causing spoiling of the product during storage and involving loss of marketable value, or those connected with quality such as presence of sandiness and thickening in sweetened condensed milk or of graining (slight heat coagulation) in evaporated milk.

Bacterial and other micro-organic faults leading to total loss are due to incomplete sterilization of evaporated or after-contamination in sweetened milk and can be prevented by rigid hygienic control of raw materials and processes at all stages. A wide experience of the behaviour and the seasonal change in the composition of milk is necessary for successful milk condensing all the year round, although modern knowledge and engineering progress have helped greatly in overcoming the most serious problems of earlier workers. It can be said that with care any milk of a reasonable quality can be successfully used for manufacturing condensed milk.

Indian milk

Little knowledge is as yet available as to the suitability of commercial milk produced in India for condensing. In any case the composition of the milk will have to be standardized to a fat/solids not fat ratio of 1 : 2·5 (this ratio in Indian cow milk is 1 : 2, and in buffalo milk, 1 : 1·3 to 1·5); this means the skimming off of some cream, and the manufacture of tinned cream from this could be profitably taken up. Milk acidity would have to be corrected, preferably by methods which would also increase the heat stability of the milk proteins, since these faults of raw milk are the most important ones with which the milk processor is faced. There is no knowledge of the behaviour of buffalo milk in the condensing process; the concentration ratio at least will be less than for western milk. Protein stability in the sterilization process of the evaporated product will have to be investigated and a study of microflora from indigenous sources which can survive the various processes is necessary.

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CULTIVATED AND WILD PLANTS

By T. S. Venkatraman, C.I.E., B.A.
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THE cultivator might have often wondered why, whereas he has to take great trouble in the growing of his crop, other plants which grow in neighbouring waste lands or even as weeds in his own fields grow easily and with much less care. This results from certain special features associated with agriculture and crop growing which are markedly brought out when a cultivated field happens to be left without the usual tilling operations and the sowing of crop seeds.

One of the first things noticed is that such a neglected field soon gets overrun with a number of different species or types of plants that differ markedly from one another in such characters as size and shape of plants, depth and extent of root systems and obviously also their intake of plant foods from the soil both in quality and in quantity. Agriculture is an attempt to establish on a piece of land only one plant species to the exclusion of all others.

Again, during the first year or two after the land is left uncultivated one might perhaps find a few plants of the previous crop from self-sown seeds, but these quickly disappear, being driven out of the land by plants which represent hardier types of vegetation, i.e. types of plant life that do not need the care and attention that agriculture connotes. Crop agriculture is thus an attempt to occupy the land with plants other than those that would grow on it without attention and this is undertaken by man in return for the food or clothing that crops yield.

Useful characters from wild types

The features mentioned above raise certain problems largely resulting from the handicaps inherent in agricultural crop growing. For solving these, the crop breeder often wishes to introduce into his crop characters not available within his own crop range and the only method available to him is to hybridize his stock with plants which are known both to possess and transmit the desired characters. Though the gradational steps in the evolution of our present crop plants from their wild progenitors are not always clear, yet there is little doubt that the available wild types of the crop represent the stock from which the crop plants have arisen through a long process of selection. It is but natural, therefore, for the breeder to look up to these in the first instance for securing the needed characters, if they are available in them. This, of course, is possible only when the crop plant hybridizes with the wild species.

Fortunately, this is so in the sugarcane and material benefits have accrued to the cane crop from such crossings both in Java and in India, the latter country being the first in the world to resort deliberately to this method. Most Coimbatore canes (Co canes) now widely grown both in India and in foreign lands have in them the blood of at least one type of the wild sugarcane or *Saccharum* and sometimes two.

Pedigree of Coimbatore canes

The results that have accrued to the Indian sugar industry from the cultivation of Coimbatore canes have been so marked that their pedigree is likely to interest the general public. It is these canes, combined with a substantial tariff protection, that have enabled the country to pass from the position of a large importer of white sugar (about a million tons) to one of surplus production within a period of a little over half a dozen years.

Thick or 'noble' canes

Before the Indian indigenous canes came to the notice of the sugar world, the term 'sugarcane' represented largely the thick juicy

Three main ancestral lines of 'Co' canes

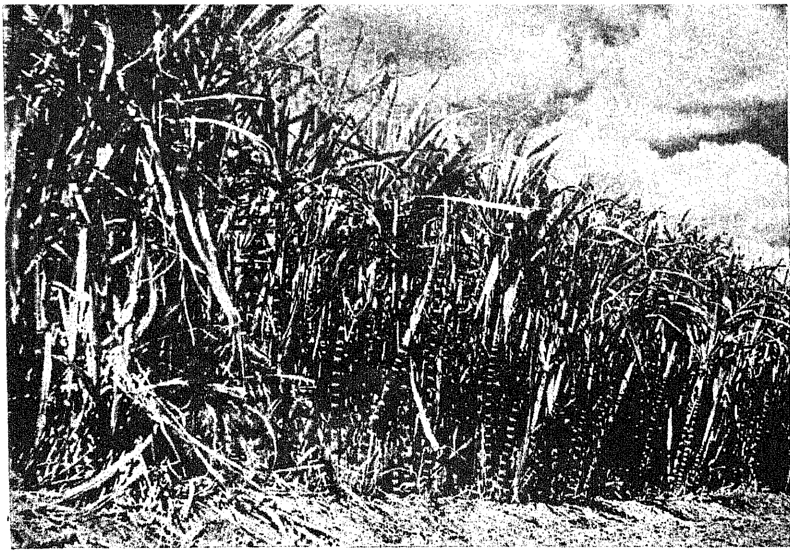


FIG. 1

Thick or 'noble' canes transmit—

Useful characters: Thick canes; Good juice quality

Defects: Poor tillering; Susceptibility to adverse conditions; Susceptibility to diseases

FIG. 2

Medium sub-tropical cane transmit—

Useful characters: Good tillering; Good juice quality; Resistance to advers conditions

Defects: Thin canes; Susceptibility to diseases

FIG. 3

Wild species of *Saccharum* transmit—

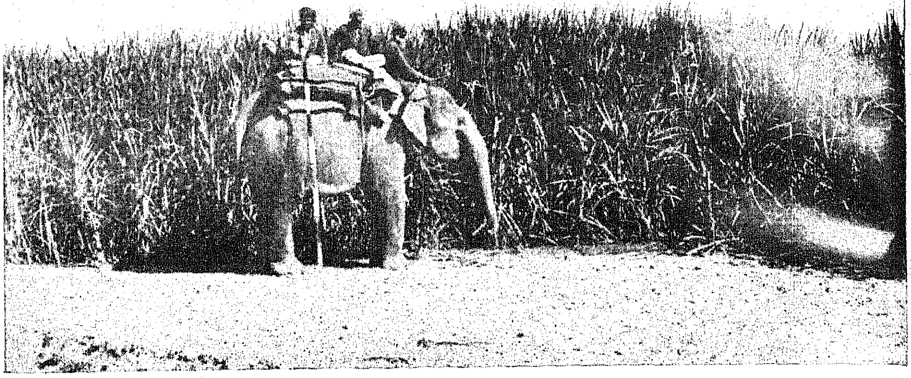
Useful characters: Good tillering; Resistance to diseases; Resistance to adverse conditions.

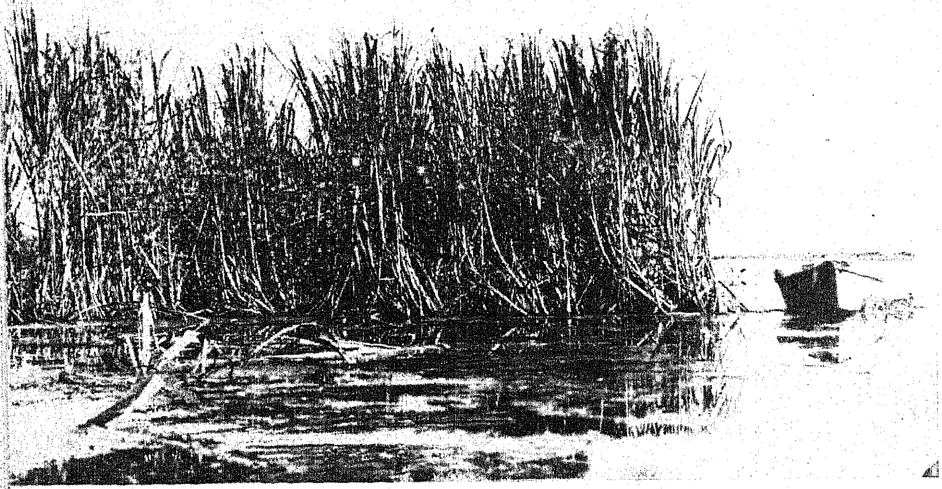
Defects: Thin canes; Poor juice quality

PLATE 98]

Resultant Hybrids (Co Canes)

Co 213 in the United Provinces
(A most cosmopolitan cane)

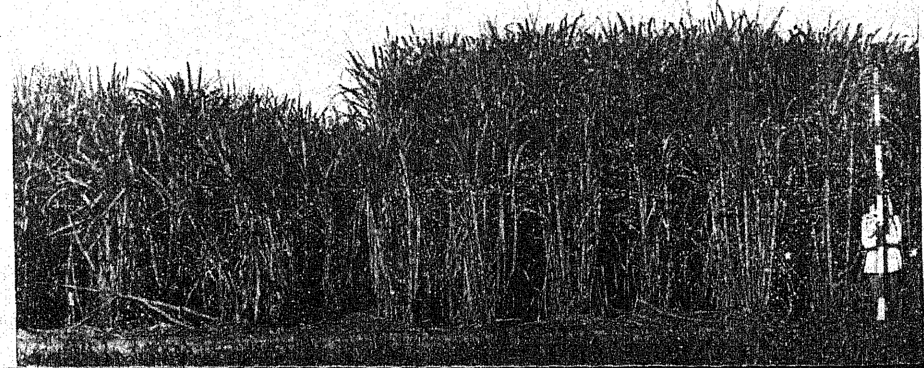




Co 281 in Florida, U.S.A.

(Resistance to waterlogging inherited from the wild grandfather)

o 421 in the United Provinces
recent Co cane alongside earlier
Coimbatore productions)



ATE 99]

canes of the tropics frequently referred to as 'noble' canes. This is the type grown in the better-known sugarcane countries of the world like Java, Hawaii, the West Indies and Mauritius. This type is grown all over tropical India and as chewing canes in subtropical India. These types generally need high-class cultivation combined with liberal manuring and irrigation. While giving good yields under such conditions, they are often susceptible to diseases and pests, and need a comparatively equable climate and other good environmental conditions for best results.

Medium canes

The indigenous Indian canes represent a class which grows well under subtropical conditions and are generally inferior to the canes of the first group both in quality and quantity of juice. Besides subtropical India, such canes are grown in South Africa, Louisiana, South Australia as also in parts of China and Japan. These canes are thinner than the 'noble' types, but often possess characters like a deeper and more vigorous root system which render them resistant to drought and frost. They possess narrower leaves and show greater resistance to certain pests and diseases than the canes of the first group.

Wild species of Saccharum

The wild species of *Saccharum* (or sugarcane)—of which there are many types—are not cultivated for their sugar but are found growing as rank vegetation in various parts of the world. They grow under conditions of neglect and are resistant to various adverse conditions such as drought, waterlogging and salinity in soil. In parts of India they constitute a major problem as weeds difficult to eradicate and special agricultural machinery has often to be employed to enable crop growing on lands infested by them. They possess very thin stems with hard rinds and extremely narrow leaves. They embody in the structure of their leaves, stems and roots, various adaptations that enable them to grow in the wild state. These are also markedly resistant to certain of the pests and diseases of the cultivated sugarcanes.

Co canes are complex hybrids

All the above three lines of ancestry, viz. (1) the 'noble' or thick class, (2) the subtropical or the medium group, and (3) the wild and hardy types enter into the pedigree of the Coimbatore canes now popular, each line contributing definite characters in the resultant hybrids. The 'noble' canes have contributed satisfactory juice values and the subtropical types capacity to grow under adverse conditions. The contribution from the wild species has largely been in the direction of partially overcoming the handicaps inherent in the rather intensive cultivation of an industrial crop like the sugarcane. Besides the above, useful characters from other genera—like sorghum (both wild and cultivated) and from the bamboo—are getting integrated into the new sugarcanes of Coimbatore from the successful hybridization of *Saccharum* with these genera.

THE MONSOON OF 1940

By K. R. Ramanathan, M.A., D.Sc.
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Monsoons are seasonal winds which flow from sea to land in one half of the year and in the opposite direction in the other half. They occur in many parts of the world, but the best-developed monsoon system is our own in south-east Asia and the neighbouring seas. In popular language, the word 'monsoon' in India is used to denote the rainfall and associated weather during the months from June to September or October. Over a large part of the country most of the annual rainfall occurs during this season. Fig. 1 (plate 100) shows the normal rainfall of the country during the five months June to October. The exceptionally good development of the monsoon system in India is due to its geographical position with the great Asiatic continent to its north and the land-flanked Indian Ocean to its south. The south-easterly trade winds of the Indian Ocean, in trying to flow into the low pressure area of southern Asia during the summer, cross the equator and enter India as south-westerly streams. The moist air-stream entering the west coast of the country from the Arabian Sea is called the Arabian Sea branch of the monsoon and that entering Burma and Bengal from the southwest and south is called the Bay of Bengal branch. The disposition of mountains round the country—the Arakan Yomas in the east, the massive Himalayas in the north and the Hindu Kush, the Sulaimans and Kirthars in the north-west—help to confine the moist air within the borders of the country and make it precipitate most of its moisture there.

March of the monsoon

The monsoon normally appears in Ceylon in the second or third week of May, and with little lapse of time in Lower Burma. Thereafter, it spreads northwards, generally in a series of pulsations, Bengal being normally reached by the first week of June and Bombay by the 10th. The Central Provinces, Gujarat and the United Provinces are reached by the end of the second week and the south and east Punjab by the end of the month. The provinces of Sind, north and west Punjab and Baluchistan never come under the regular sway of the moist currents; they are only affected by its occasional incursions in July and August. The southward march of the monsoon commences from the north Punjab in the third week of August. By the end of September, the area to the west of the line running approximately from Bombay to Bahraich (in the United Provinces) is clear of rainfall and by the end of October, the only portions of the country having rainy weather are parts of the Madras Presidency, Mysore and Ceylon.

The rainfall of the monsoon season in any part of the country does not take place uniformly. It occurs in spells—the wetter spells being more frequent in regions such as the Malabar and Bengal coasts where the monsoon first enters the land and the drier spells becoming more and more frequent as we penetrate inland towards north-west India and Baluchistan. During the monsoon months, and especially in July and August, cyclonic depressions often form at the head of the Bay of Bengal and travel westward towards the Aravallis. A few of these penetrate into Sind and Baluchistan. These monsoon depressions have a great influence on the rainfall during the season. Indeed, except in the regions where the rainfall is mainly due to orography, the history of the monsoon rains is a history of its depressions.

Considering specifically the monsoon of 1940, a temporary advance of it occurred in Ceylon and the west coast of the Peninsula in the third week of May. At the same time, it also advanced into Bengal and Assam under

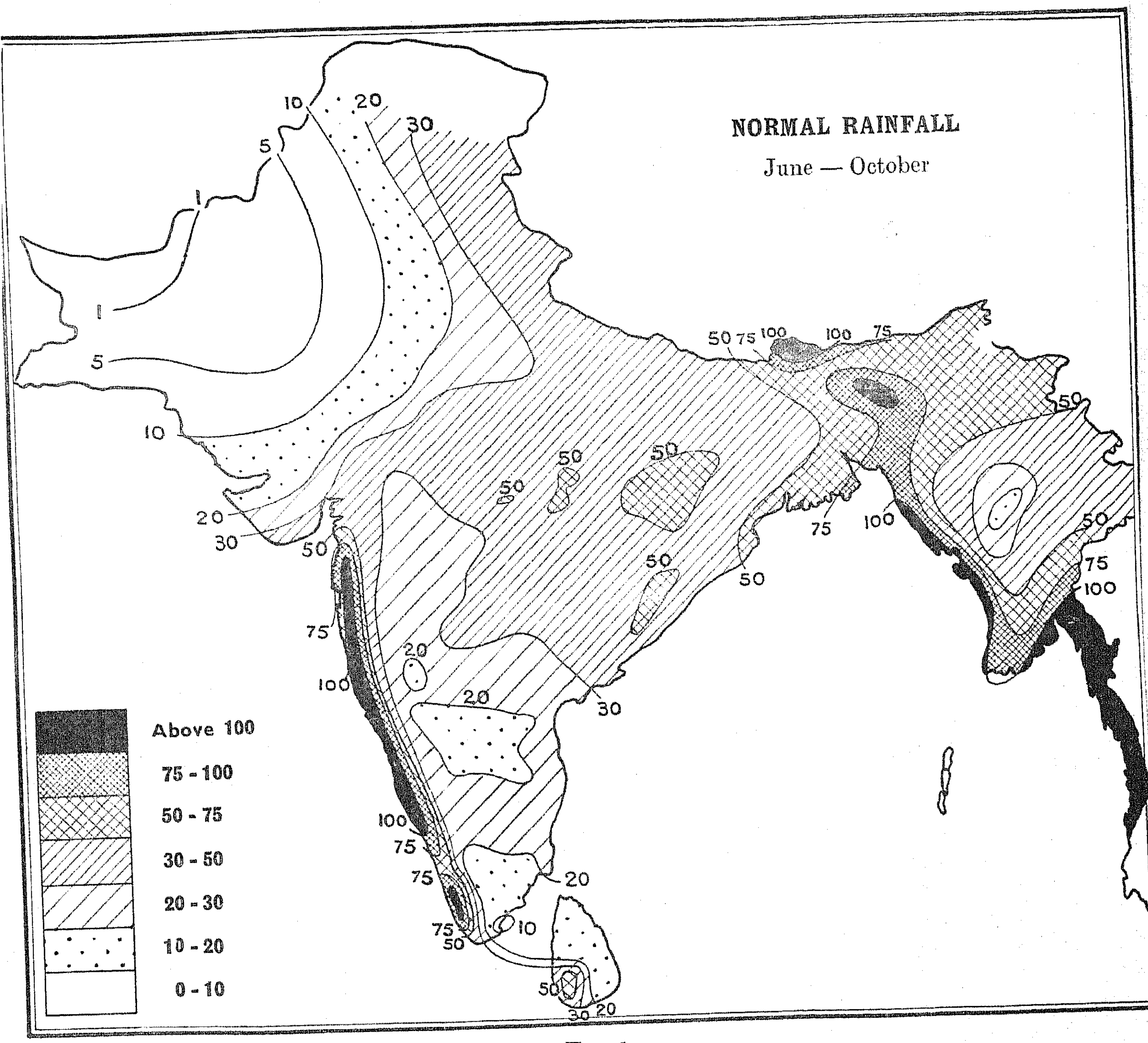

NORMAL RAINFALL
June — October
Above 100
75 - 100
50 - 75
30 - 50
20 - 30
10 - 20
0 - 10

FIG. 1

PROGRESS OF THE MONSOON DAY BY DAY

June to September 1940

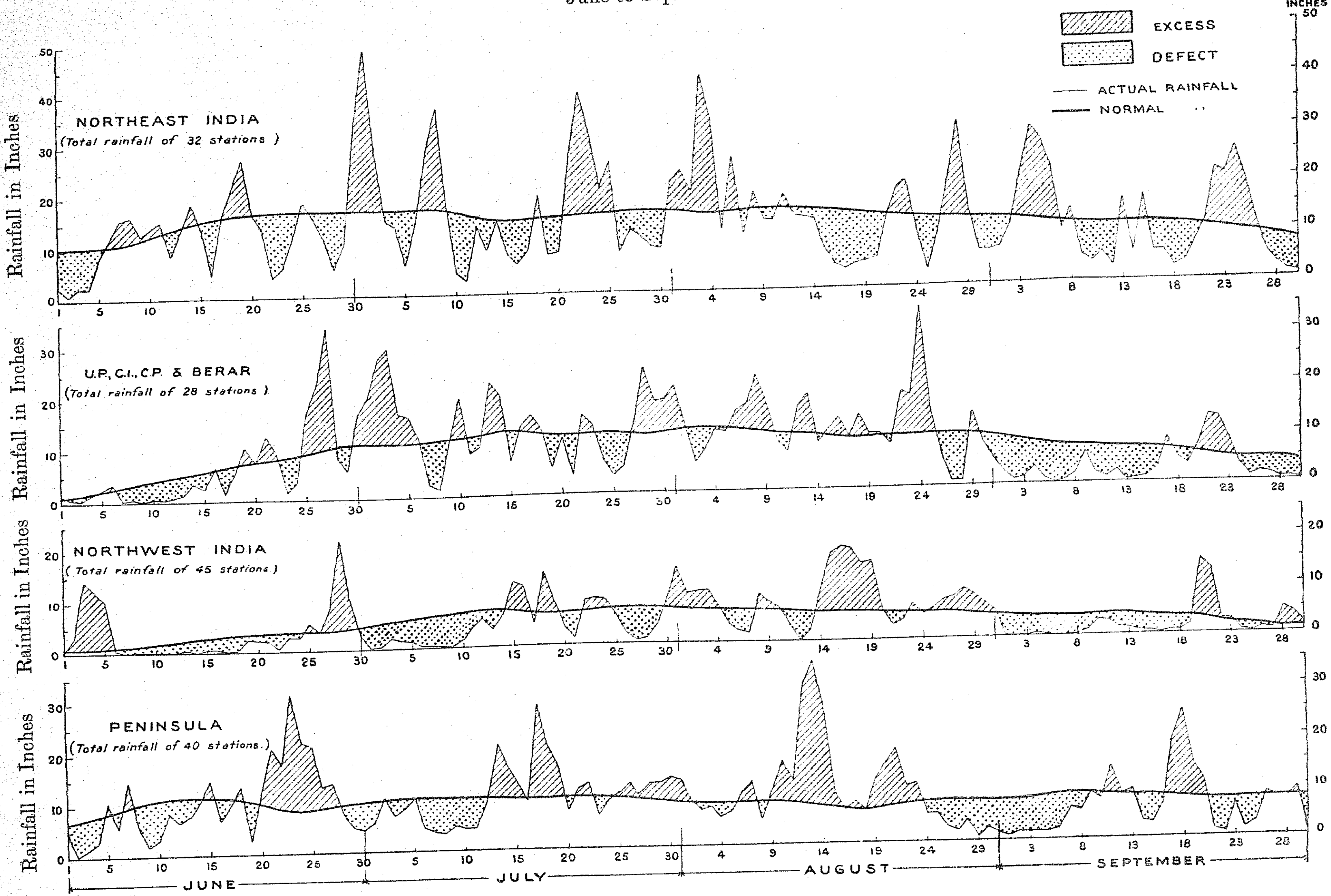


FIG. 2

the influence of a cyclonic storm from the Bay of Bengal. This advance was not, however, maintained. In the first week of June, an active western disturbance was responsible for some good rain in north-west India and with its movement towards Bengal, the regular monsoon may be said to have commenced there. The Arabian Sea monsoon was rather late in arrival and its real advance took place only by about the middle of the month. Two cyclonic storms which originated near the head of the Bay and subsequently moved westward caused widespread rainfall from Orissa to the Konkan and Gujarat. Orissa came in for an extra large share of rain—causing floods in the Baitarani and the Mahanadi and some loss to property.

Progress of the monsoon

The monsoon extended to west Rajputana and Sind only in the third week of July with the result that in the first two months, June and July, rainfall was in defect in north-west India. August was a month of well-distributed good rainfall—the rains also extending to north-west India and Baluchistan. Both branches of the monsoon withdrew rather early, the Arabian Sea branch on the 24th August and the Bay branch by the end of the month. September was a month of defective rain, the only wet period being in the third week of the month when both the branches of the monsoon temporarily revived in connection with two depressions from the Bay.

The progress of the monsoon day by day in the period June to September in each of the major divisions is shown in Fig. 2 (plate 101). For comparison, the normal rainfall of each day is also shown by a smooth continuous line. The excesses and defects are shown by separate shading. The diagram brings out clearly the non-uniformity of the monsoon rainfall and the inter-connection between spells of wet and dry weather in different regions of the country.

Fig. 3 (plate 102) shows the amounts of rainfall in each of the sub-divisions of the country during the period June to September expressed as a percentage of the normal. The only regions where there was appreciable excess of rain were Orissa, west central India and the west Central Provinces and the main regions of defect were the North-West Frontier Province, east central India and Bihar, but comparing their abnormalities with those that may be usually expected (see the table below) only the excess in Orissa and the defect in the North-West Frontier Province and east central India can be considered unusual.

Division		Average Rainfall in 1940	Percentage departure from normal in 1940	Percentage mean deviation based on 50 years' data
Bay of Bengal Branch	Assam	59	—4	8
	Bengal	59	—3	10
	Orissa	59	+34	11
	Bihar	37	—15	16
	United Provinces	32	—11	18
Arabian Sea Branch	Madras	26	+2	11
	Bombay	30	+2	15
	Central Provinces and Berar	47	+16	17
	Mysore	17	+13	19
	Hyderabad	28	+7	19
Combined Branches	Central India	30	—12	17
	Rajputana	18	—1	25
	Punjab	13	—10	28
	N.-W. F. Province	2	—59	28
	Sind	4	—21	57
	Baluchistan	2	—27	47

The decreasing amounts and increasing year-to-year variabilities of rainfall shown in the first and last columns of the table as we proceed from Bengal to the United Provinces and then to the Punjab, Sind and Rajputana are worthy of note.

The effect of the early withdrawal of the monsoon is well shown by the rainfall anomalies in September shown in fig. 4 (plate 104).

Considering the season as a whole, the monsoon of 1940 arrived rather late and withdrew early; but during its period of activity, the rainfall was steady and well-distributed.

AGRICULTURAL IMPROVEMENT MEANS AGRICULTURAL EDUCATION

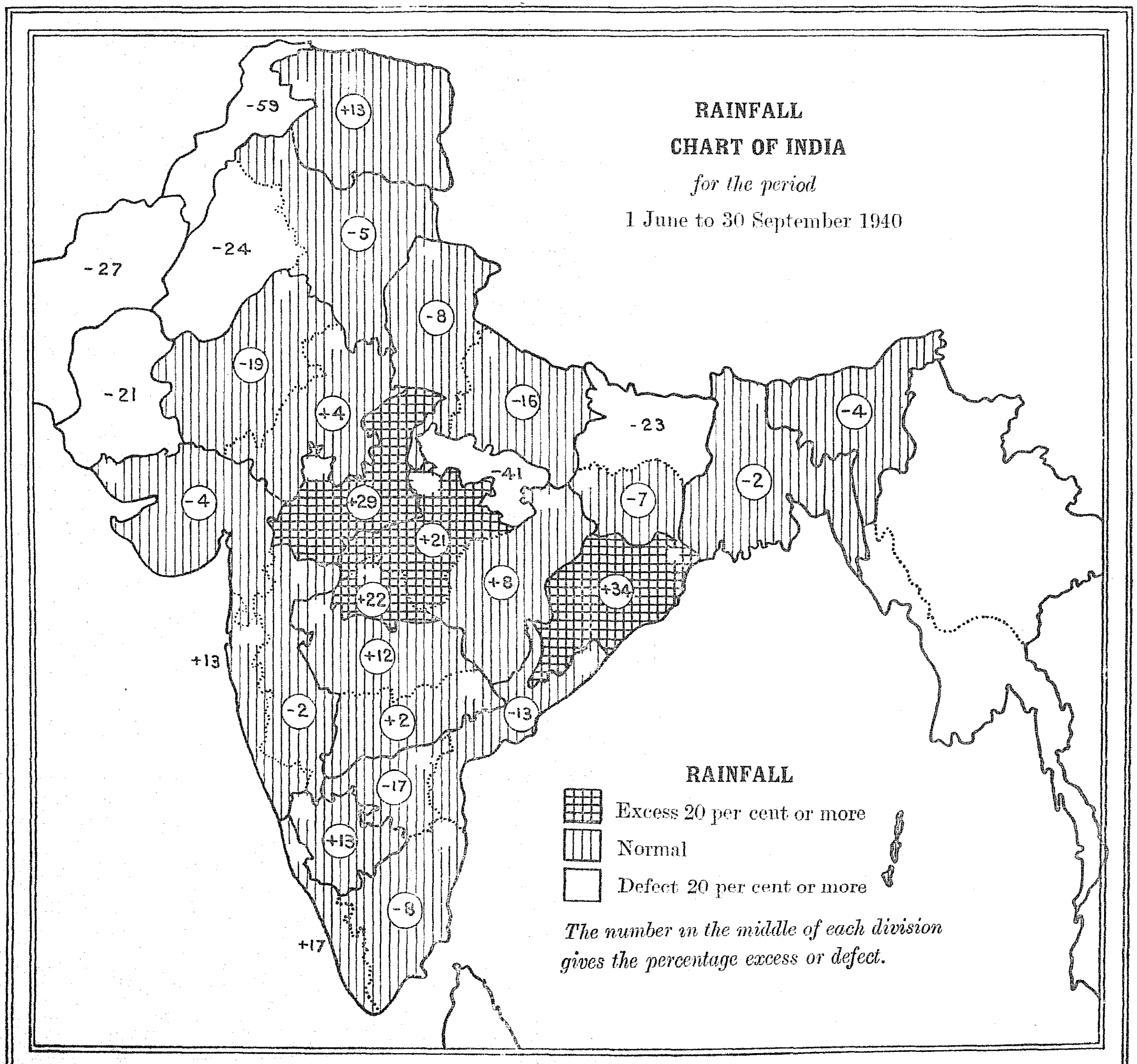
THE present lack of training facilities for young people in agriculture is probably largely responsible for the lag there is in the industry between the proved value of new knowledge and its application. In contrast with this we have the gratifying and, indeed, remarkable fact that great additions to our knowledge of agricultural problems have been made by British scientific workers in many branches during recent years and, alongside them, the demonstration of their commercial value has been proved in many directions. The feeding of livestock, the improved treatment of grassland, the value and preparation of ensilage, improved knowledge of manuring and many improved methods in vegetable and fruit production are familiar examples. It is not too much to say that the names of some of our chief agricultural research workers and of their institutes are known all over the world, but I believe it is true to say that there are thousands of British farmers who have only the vaguest idea as to what these men stand for—if any idea at all.

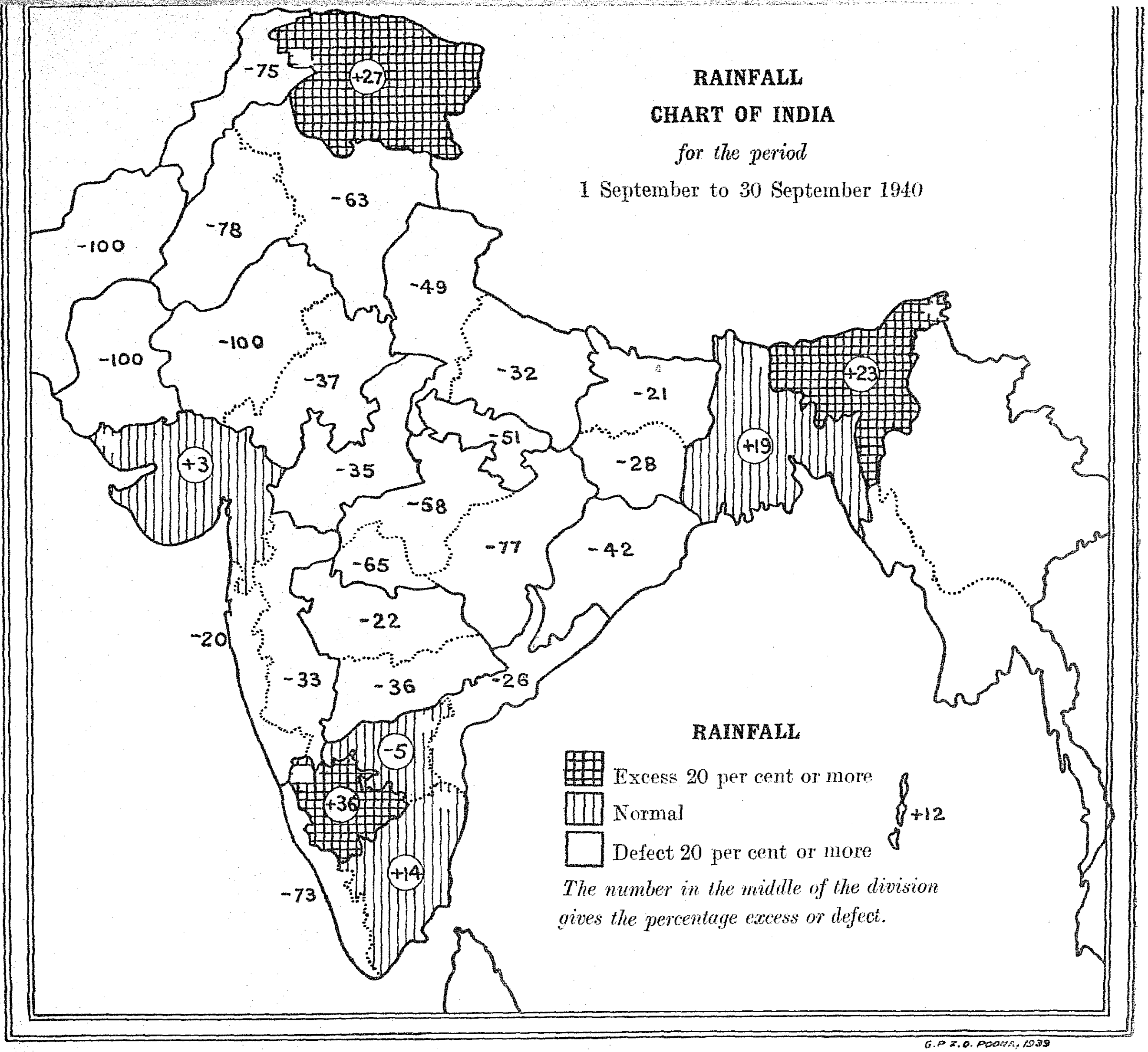
Our agricultural colleges and institutes and the staffs employed by county councils have done splendid work in evoking the interest of farmers and in spreading knowledge in the face of great difficulties, but I have not met one of them who is not impressed by the need for more—very much more. There is this to say also, that, where the possibilities arising out of the application of new knowledge are brought home to them, there is a responsive spirit in the industry. Those of us who have attended young farmers' clubs and meetings of farmers, especially when there has been a good proportion of young farmers present, must have been impressed by the keenness displayed by many. There is a great field ripening for harvest in agriculture. But the reapers are far too few.

The question is: How are we to secure the more rapid infiltration into the practice of the industry of the lessons of new knowledge of proved value, and thereby lift up the standard of those engaged in it?

We need, I think, to do something affecting education generally at the beginning. There should be a great extension of the vocational elements in education in rural areas with facilities for transition to institutes for suitable candidates.

It is true that a good general education is an essential basis for us all. But our educational standards have been far too much dominated by a traditional leaning to, what may be described as, the arts side in prescribing the character of our education in rural areas for older children. We have the great laboratory of nature at our door and far too little use is made of it. One knows, of course, that many schools are to be found in rural areas where an enterprising teacher has developed this side of the school work with splendid results, but the dependence is far too much upon the enterprise of the individual teacher. The impulse is not provided in anything like the measure it ought to be in our educational system.—The Rt. Hon. LORD ADDISON, P.C., 'Farming after the War', *The Field*, 2 November 1940.


RAINFALL
CHART OF INDIA
for the period
1 June to 30 September 1940
-59
+13
-24
-27
-5
-8
-19
-21
+4
-16
-23
-4
-41
-2
-7
-4
+29
+21
+8
+34
+22
+13
+12
-2
+2
-13
-17
+15
-8
+17
RAINFALL
Excess 20 per cent or more
Normal
Defect 20 per cent or more
The number in the middle of each division
gives the percentage excess or defect.



RAINFALL
CHART OF INDIA
for the period
1 September to 30 September 1940
-75
+27
-63
-78
-100
-49
-100
-100
-37
-32
-21
+23
+3
-35
-51
-28
+19
-58
-77
-42
-65
-22
-20
-33
-36
-26
-5
+36
+14
-73
RAINFALL
Excess 20 per cent or more
Normal
Defect 20 per cent or more
+12
The number in the middle of the division gives the percentage excess or defect.
G.P Z.O. POONA, 1939

FIG. 4

MUSHROOM CULTIVATION IN INDIA

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As is well known, the cultivation of mushrooms is an important industry in many European countries and in America. They form a palatable and wholesome, though not very nutritious, food. Since, in addition, various fungi occurring in India are eaten with relish, it is quite natural that many enquiries should be received about the possibility of their cultivation.

What is a mushroom?

In the first place, we should perhaps clarify our meaning of the term 'mushroom'. In its narrow and perhaps more correct sense as used in England and America it refers only to the fungus *Psalliota campestris* (L.) Fr., but in its wider sense it may mean any edible fungus. Of these a number occur in India. In Kashmir and in certain parts of the Punjab the fungus *Morchella esculenta* (L.) Pers. is a popular form of food and is frequently dried, in which condition it may be safely stored for long periods. In Bengal *Volvaria terastria* B. and Br., *Lepiota albuminosa* Berk., *L. mastoides* Fr. and *Psalliota campestris* are all eaten by villagers. A different species of *Volvaria*, *V. diplasia* Berk. et Br. is a popular form of food in Burma. The fungus *Podaxon pistillaris* (L.) Fr., is eaten in certain districts of the plains where it grows wild.

The possibility of cultivation of certain of these forms in India may be envisaged, and amongst those in which some success seems to have been achieved are *Volvaria diplasia* Berk. et Br. (see Thet Su and Seth, 1940), *Panæolus cyanescens* B. and Br. and *Coprinus niveus* Fr. It is not, however, to these fungi that most of our enquiries refer, but to *Psalliota campestris* (plate 104), the so-called 'common mushroom' or 'edible mushroom'. This is the fungus which has been cultivated with such success in America and Europe, which is popular almost the world over, and the cultivation of which has been tried, often without success, in India. It is proposed to point out here the possibilities and the obstacles to cultivation.

Spawn: varieties

The 'mushroom' as picked and eaten represents only one of the phases in the life of the fungus. It is the fleshy and very elaborate 'fruiting body', being a cap or umbrella-like structure borne on a stalk. If the cap is removed from the stalk and inverted, it will be seen that the under-surface has, apparently radiating from the centre (though actually not attached at the centre at all), a number of thin, paper-like, flat structures which are pink in young mushrooms and dark-brown to almost black in older ones. These bear the tiny 'spores' which in the mature fungus are produced in immense numbers and can be collected as a fine brown powder. These spores are so light that they may be readily blown around by the wind. When they alight on a suitable medium they germinate and produce a microscopically fine tubular structure which eventually branches and forms a white cottony growth, technically known as the mycelium, and popularly called the 'spawn'.

In order to cultivate mushrooms, it is necessary to plant a suitable bed with spawn. There are now two types of spawn commercially used, and these are known as 'brick spawn' and 'pure-culture' or 'bottle spawn'. The preparation of either kind is a highly specialized process which the amateur will find difficult or impossible, but the methods may be of interest and will be briefly described.

How to prepare spawn

There are two steps in the preparation of brick spawn. First of all, 'virgin spawn' has to be found. When the spores of the fungus fall on horse-dung they germinate and produce a fine weft of white mycelium which

ramifies the dung and gives it a whitish appearance and a peculiar odour. Experts are able to distinguish this readily, and it is considered preferable to collect the naturally occurring material rather than manufacture it. The second step is the manufacture of the bricks themselves. Cowdung, or a mixture of cowdung, horse-dung and loam in a moist but not wet condition is moulded into compact bricks measuring about $9 \times 6 \times 1\frac{1}{2}$ in. These, when sufficiently dry, are stacked together and small pieces of virgin spawn are placed between the bricks. The stacks of bricks are covered to preserve moisture and are kept at a temperature of about 60°F. until they are ramified by white mycelium, after which they are slowly dried and are ready for use.

Pure culture spawn is prepared by growing the mushroom tissue obtained from a good type of mushroom on horse manure sterilized by heating under pressure. By adopting this pure culture method all other fungi and bacteria are entirely excluded and a particularly rich growth of the mushroom spawn alone is obtained. The method requires, of course, the proper laboratory equipment and skill in pure-culture technique for which special training is necessary. The mature spawn is either sold in bottles or dried and packed in cartons. Recently Miss Cayley [1937] has had considerable success in growing spawn by the pure culture method without the use of horse manure. The mixture used consists of two grams each of dry chopped straw and dry chopped hay moistened with 10 c.c. of rain water, two grams of crushed oats and half an ounce of coarse sand being added later. The mixture is placed in a culture tube $8 \times 1\frac{1}{2}$ in. in size. It is lightly pressed down, and a layer of dry sand is placed on the surface. The whole is then moistened with 10 c.c. of Styer's nutrient solution A, consisting of $MgSO_4$, 0·02 M, K_2SO_4 0·01 M, KH_2PO_4 0·04 M, $CaCl_2$ 0·002 M, $FeSO_4$ (trace), NH_4NO_3 0·1 M, and enough NaOH to bring the *p*H to 6·0. The medium is sterilized on three successive days.

Preparing beds

The preparation of the beds on which the mushroom crop is to be grown again demands skill and experience. By far the best material is horse-dung obtained from stables in which abundant wheat-straw has been used for bedding. When other materials are used for bedding attempts to grow mushrooms often meet with failure. The manure must be fresh and must not have been exposed to rain. The manure as obtained from the stable in a damp condition is placed in a well aerated dry shelter and is made into long piles of roughly triangular cross-section and not more than six feet high. After three or four days, when the pile begins to steam and give off an odour of ammonia, it is opened up and rebuilt, care being taken to place innermost what was previously the outside portion. The process is repeated three or four times, the heat produced by fermentation on each occasion becoming less. At most, however, the temperature should never rise above about 160°F.; if it does so, the pile must at once be broken up and remade.

Cultivation requirements

In temperate climates it is possible to grow mushrooms successfully out of doors during certain periods of the year. It has to be remembered, however, that of all factors in the culture of mushrooms, temperature is the most important and the most difficult to control. Sharp differences between day and night temperatures must be avoided, and the aim should be to maintain a temperature of about 50 to 65°F. Furthermore, the beds must never be allowed to become soaked with water. Both these factors would appear to mitigate against successful outdoor cultivation in India. It may also restrict successful growing to the cold weather unless it is found that the Indian varieties of mushroom can withstand a higher temperature than those from Europe and America, which may possibly be the case. It is just possible that cold storage godowns now being erected in many parts of India for storing fruits and vegetables during hot weather might be utilized for mushroom cultivation during the colder months when space is available. Light is unnecessary for their cultivation.

Procedure

Assuming, therefore, that indoor cultiva-

tion is to be practised, we may outline the procedure after the compost is in a fit state for bedding. The beds may be prepared directly on the floor or on raised shelves, and several tiers of shelves may be built provided there is sufficient height. Such shelves should be at least 3½ ft. apart. The prepared manure is now placed on the shelves to a depth of about ten inches and then beaten down to about six or seven inches. The manure should be slightly damp but not distinctly wet ; it is of correct moisture content when it can be squeezed and moulded by hand but the lumps so formed can be readily broken up again by slight pressure. If the manure has been correctly fermented, the temperature will gradually rise to about 100 to 140°F., but not higher, in about two days, and will then gradually fall. If found to rise higher, the beds must be loosened up to allow escape of heat and then closed again.

When the internal temperature of the pile has dropped to below 80°F. the bed should be 'spawned'. If pure culture spawn is used it is broken into small pieces about the size of an egg, and these pieces are planted in the bed, one piece per square foot, half an inch or an inch below the surface. About a week or ten days later the bed is 'cased' by covering with a layer of about 1½ to 2 in. of soil. This soil should be a light loam, with neither too much sand nor too much clay ; it should not be a cultivated top-soil but preferably should be taken from at least a foot below the soil surface. Unless the soil is very chalky a small quantity of lime should be added before using. All stones should be removed. It should be in a damp and friable condition and should be tapped down lightly on the surface of the bed. Drying out of the bed may be prevented both before and after casing by covering with a layer of six to twelve inches of straw. It is desirable not to add moisture but rather to conserve it, but if the surface is at any time allowed to dry out moisture should be sprinkled over it lightly.

Importance of temperature

Mushrooms should begin to appear from four to ten weeks after spawning, but the actual date of their appearance will depend upon temperature. A temperature of 55 to 60°F. has been found to bring on the crop most quickly in England, but a lower temperature usually results in a heavier crop.

Growing mushrooms in beds of artificial compost made of straw and hay, to which is added ammonium sulphate, potassium phosphate and lime has met with partial success in experiments conducted by Cayley [1938], but up till the present the crop yields have not been heavy and the mushrooms have been very slow in maturing. It is hardly a commercial proposition yet, but the time may come when methods of this sort are widely adopted. Such methods have met with considerable success in cultivating *Volvaria diplasia* in Burma.

It will be seen that mushroom growing is a complicated process and that temperature and humidity are vital factors. There are, however, many additional difficulties which face the grower in the form of diseases and pests. Several other fungi, notably *Mycogene perniciosa* Magn., can parasitize the mushrooms and cause them to decay rapidly. It is particularly troublesome at high temperatures and in very humid atmospheres. If it appears in the beds the infected mushrooms must at once be removed and destroyed by burning. If a single isolated bed is infected it is advisable to pour on the bed a solution of 0·1 per cent corrosive sublimate or Bordeaux mixture as used in spraying plants for prevention of mildew and other diseases ; the bed will then be destroyed but spread of infection to healthy beds may be prevented. The real necessity, however, is to prevent entry by thorough cleanliness, all walls and woodwork being scrubbed with a dilute formalin solution before making up the beds. Pure cultures eliminate the possibility of introducing the disease with the spawn.

How to deal with insects

Insect pests are also a constant source of trouble. Flies lay their eggs in the beds and the maggots which grow rapidly can soon destroy the entire crop by invading the mushrooms themselves. Mites may also become troublesome if temperatures are high, and in addition to attacking the mushroom tissue

they are able to feed upon the mycelium or spawn. Fumigation with nicotine may control flies, but mites are extremely difficult to deal with when they have once gained a hold. Here again cleanliness is necessary, and will be particularly so under Indian conditions. Proper fermentation of manure, use of pure cultures, prevention of accumulation of decaying animal or vegetable matter in the neighbourhood of the mushroom sheds, the proper regulation of temperature, and provision of good ventilation, are essentials in mushroom culture.

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Those who wish to give further consideration to the possibilities of development of this industry in India should pay serious consideration to the difficulties and must take full account of the most serious problem, temperature. Much useful information may be gained by a careful study of the following references.

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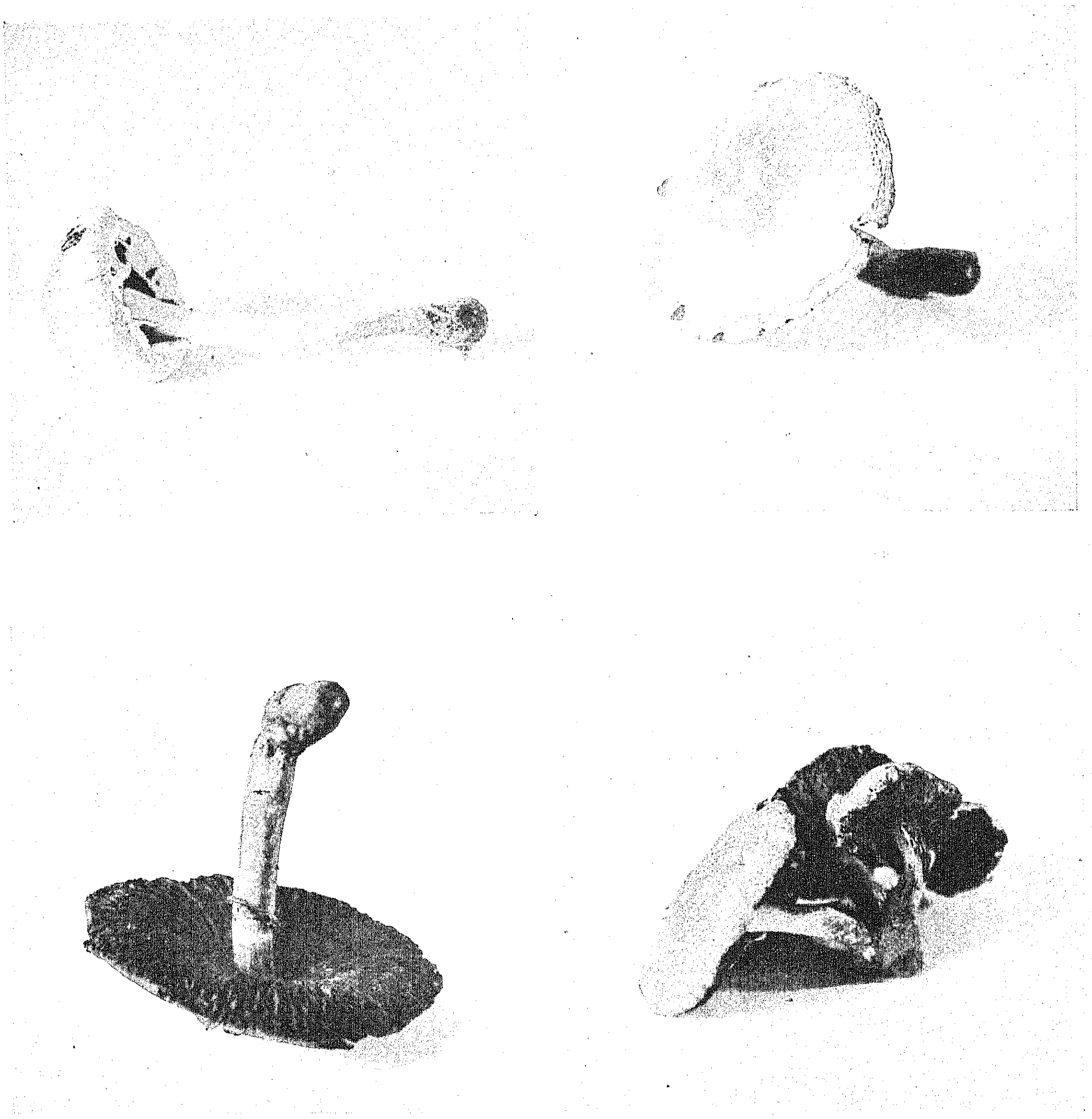

Common wild mushrooms *Psalliota campestris* (L.) Fr. collected in Delhi in August, 1940

The Commissioner, Ajmer-Merwara, inspecting the dry farming experiments at the Tabiji Farm

TE 105]

AGRICULTURE IN AJMER-MERWARA

By Rao Bahadur V. A. Tamhane, M.Sc., M.Ag., I.A.S. (Retd.)
Agricultural Officer, Ajmer-Merwara, Ajmer

THE province of Ajmer-Merwara is peculiarly situated so far as the general rainfall is concerned. Unless it is very strong, the south-west monsoon crossing the Indian peninsula via Malabar, Bombay and Kathiawar gets almost exhausted before it reaches the south-western part of Ajmer. The north-east monsoon coming via the United Provinces, Delhi and Rajputana precipitates most of its moisture on its way before it reaches Ajmer. Yet this latter is the main source of rain for Ajmer, and unless this north-east monsoon is strong enough Ajmer does not get its necessary quota of rain for successful growth of crops. Ajmer is sometimes visited by a few showers of rain coming from the north-west also, but these are very scanty and few in number and are only showers deflected in their course from the north-east. Thus Ajmer is situated on the fringe of the monsoon zones and is exposed to repeated famines. Almost every seventh year there is scarcity or famine and a cycle of about 30 years has been calculated for the recurrence of a very severe type of famine extending over the whole area for a number of years.

A dry region

The topographical nature of the province is also peculiar. The province is situated on a plain which is nearly 1,800 ft. above the sea-level and which slopes outwards on all sides. Hence a very large portion of the rainfall on the plain is not being retained for the benefit of the province; it runs off in several directions and away from the province. That towards the southern side finds its way by the river Chambal to the Bay of Bengal. That towards the north-west is discharged by the Luni river into the Gulf of Cutch. That towards the south-west runs through several streams into the Banas which is the only perennial river running through the extreme south-eastern corner of the province.

The only means of retaining rain-water in the plain has been to impound it in tanks of which there are many constructed by both Government and the public, while the natural reservoirs are only four in number, viz. (1) Pushkar lake, (2) Budha Pushkar, (3) Sargaon and (4) Kurantia. Of these the first two are depressions among sand hills without any outlet and exercise considerable influence by percolation through the sand hills supplying water to wells in the neighbourhood and allowing cultivation of crops even like sugarcane which can be grown there almost without surface irrigation. The third, viz. Sargaon, has been cut through and a passage made for the water to run through the country, the bed being cultivated with spring crops. The last, viz. Kurantia, lies amongst rocky hills and is of no use for irrigation.

There is no permanent supply of water in the wells of the province. Almost all the wells depend on rainfall. And as the cultivators have to depend only on such wells for irrigating their crops the province abounds in such wells. In 184 villages of the Ajmer tahsil alone there are about 2,500 wells of which only half offer a moderate quantity of water while others dry up or give only small quantities of water.

Government efforts

The Government are making great efforts to increase the productive capacity of the province to avert the effects of the recurring famines. For this purpose Mr B. J. K. Hallowes, the present Commissioner of Ajmer, arranged to have a geological survey of the province made in order to ascertain if there is sufficient subsoil water which can be tapped and utilized for irrigation purposes by

sinking tube-wells as in the United Provinces. But the geological survey only revealed that conditions in Ajmer-Merwara were not favourable for extensive tube-well irrigation schemes, as the whole of Ajmer-Merwara is made up of metamorphic and igneous rocks with a covering of overlying alluvial sediment which is too thin for the purpose in question. For a successful tube-well irrigation scheme a thickness of over 200 ft. of porous unconsolidated alluvium is essential, whereas over a greater part of Ajmer-Merwara it is only about 50 ft. in thickness. In the hard metamorphic and igneous rocks below, there are hardly any pore spaces, and water is held only by joint planes, bedding planes and fissures, and tube-wells cannot be successful under such conditions. A well may, by chance, strike a wide fissure in the hard rocks, but this will only be in exceptional cases. Besides, for irrigation purposes, the replenishment of the tube-wells must also be satisfactory. It has been estimated that for good replenishment an annual rainfall of 25 in. is necessary, and Ajmer-Merwara gets this amount of rainfall only rarely.

Declining rainfall

The average rainfall of the province is getting less and less mostly because the former forests, which were described as thick 'impenetrable jungles' in 1819 have been cut for fuel and no new forest trees outside Government forests have been planted in their stead. Thus by 1870 these jungles almost disappeared and wood of all kinds became scarce. The following figures show how the rainfall has gradually decreased since 1870.

Years	*Average rainfall in inches*	
1869-1879 .	24	Giving an average of 22 in. for the 30-year period.
1879-1889 .	22	
1889-1899 .	20	
1899-1909 .	19	Giving an average of 19 in. for the next 30-year period.
1909-1919 .	$18\frac{1}{2}$	
1919-1929 .	$19\frac{1}{2}$	

During the last two years, i.e. 1938 and 1939, the annual rainfall was hardly 10 inches, with the result that a severe famine spread over the whole province.

In the face of the hard facts that there are no large-scale irrigation facilities in the province and that the rainfall is scanty, the only way of increasing the present productive capacity of the province in the case of both food and fodder is to resort to dry farming as already suggested by Dr W. Burns, Agricultural Commissioner with the Government of India. Such efforts are now being made at the Tabiji Farm near Ajmer by the Superintendent, Mr M. C. Joshi, under the management of the District Board and lately under the technical control of the newly appointed Agricultural Officer.

Jamnagar bajra

In addition to the perennial grasses under irrigation, viz. Napier grass, Guinea grass, Rhodes grass, etc. and some local grasses, e.g. *dhaman* (*Cenchrus biflorus*), *karar* (*Andropogon contortus*) and *seran* (*Elionurus hirsutus*) the Jamnagar and local *bajra* (*Pennisetum typhoideum*) were sown on *barani* (unirrigated) land in March 1940 on the moisture left in the soil by the few showers of rain which usually fall in January-February. Both kinds of *bajra* germinated fairly well, but the Jamnagar *bajra* showed more drought-resisting qualities than the local *bajra* inasmuch as subsequent deaths were fewer in the Jamnagar *bajra* than in the local. In the first week of June there was a rainfall of about three inches and the plants began to grow faster, but soon there was a break in the rains till almost the middle of July, and yet the Jamnagar *bajra* did not fail but actually did much better than the local. The drought-resisting capacity of the crop, however, could not be tested further as there was very good rainfall subsequently from the end of July to the middle of September.

Fodder supply is the most urgent necessity of the province as otherwise hundreds and thousands of our cattle migrate to other places in search of fodder. Every precaution is being taken by Government to import fodder from outside and open fodder depots when necessary. But now efforts are also being made to grow fodder especially under dry-farming methods. The accompanying photograph (plate 105) shows Jamnagar *bajra* grown under dry-farming

methods being inspected by the Commissioner, Ajmer-Merwara, who is now encouraging the opening of a small 'dry farm' for further trials.*

The full height of the Jamnagar *bajra* plants including the earhead is 13 ft. 3 in. as compared to the 7 ft. 5 in. of the local *bajra* which, moreover, is not so drought-resistant as the Jamnagar variety. If, as is probable, the Jamnagar *bajra* could be sown successfully in March, it will provide green fodder for cattle when there is hardly any green fodder available in the country. From the middle of April to the middle of June and from mid-October to mid-February there is absolutely no green fodder in the province, and the effect of this scarcity is likely to be appreciably mitigated if the Jamnagar *bajra* could be successfully grown from March on the moisture left in the soil by the usual few showers that fall in January-February and on *abi* lands, i.e. lands that are submerged under water in tanks during the monsoon but are dry on the surface during the spring. The necessary trials will be undertaken in the near future. Also the possibility of storing green fodder in silos will be investigated.

* We understand Jamnagar *bajra* has been tried in various parts of India with varying results. We would appreciate further information as to its performance.—*Ed.*

VACCINATION AGAINST RANIKHET DISEASE

AT the Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, England, S. Ganapathy Iyer, an officer deputed by the Imperial Council of Agricultural Research for training in poultry diseases, and N. Dobson have been engaged in research for evolving a suitable vaccine for the control of Ranikhet disease, the results of which are published in the *Veterinary Record*, Vol. 52, No. 52. As this disease causes enormous annual losses and is the greatest of all fowl scourages in India, it will be a matter of great relief for the Indian poultry breeders to know that these workers, by employing a special technique of serial inoculations of the developing chick embryo with the virus of this disease, have succeeded in developing a method for the production of a safe and reliable vaccine with excellent immunizing qualities. It is hoped that this vaccine will be available for use in this country before long.

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HOSUR SINDHI HERD

IN 1921 two Sindhi cows in milk were purchased from Karachi and a further six cows from the Madras Hygienic Milk Supply Company (which went into liquidation) for the Agricultural College Dairy, Coimbatore. In June 1923, the Livestock Section took charge of the dairy herd at the Agricultural College. The Madras Agricultural Department acquired the Hosur Remount Depot in September 1924 for a cattle-breeding station and the small herd of Sindhi cows was eventually transferred to this station. In 1925, 12 Sindhi cows were purchased from Karachi and another 18 cows were purchased in 1928.

Breeding by selection has been carried on for the last 15 years at Hosur. Accurate particulars of each animal are maintained in the permanent Cow History and Bull Registers, and the full pedigree of any animal is available on the farm.

The first two breeding bulls of this herd were the sons of cows 24 and 25 which were both very good milkers. Cow 24 averaged 4,997 lb. with a daily average of 15·2 *lb.*, her highest yield being 8,244 lb. and cow 25 averaged 5,649 lb. with a daily average of 16·9 lb., her highest yield being 6,861 lb. Bulls from these two strains are still used as sires for the herd, along with one unrelated bull.

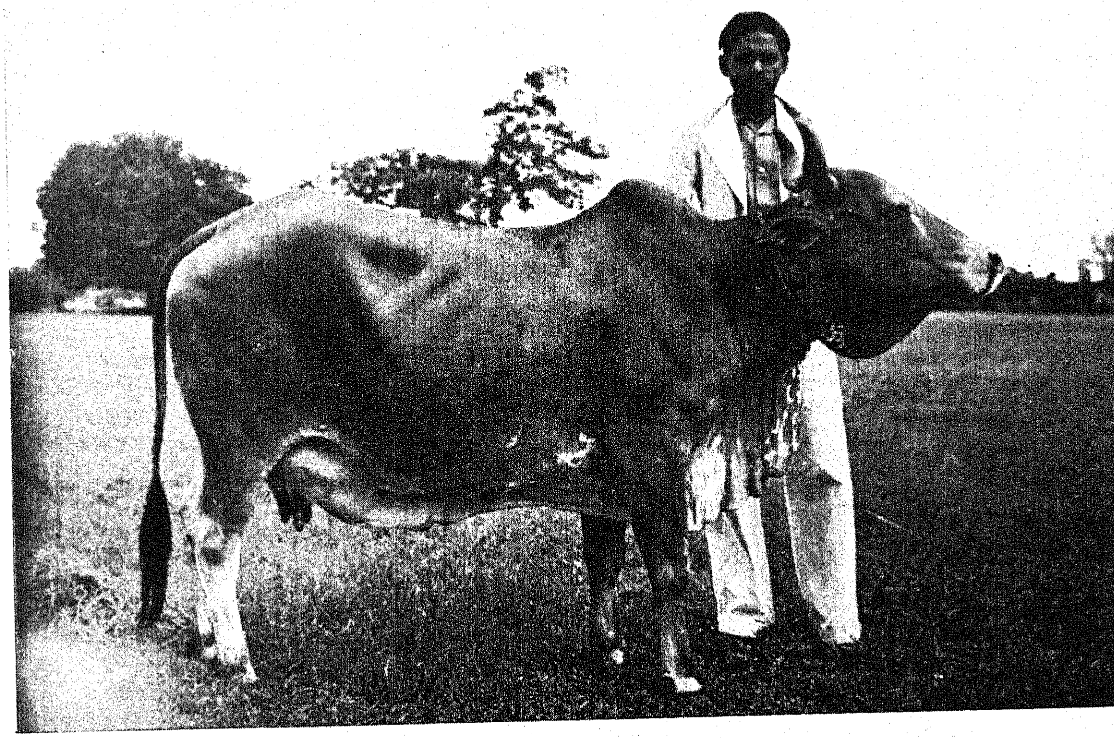
There are at present 58 cows in the farm herd which have completed one or more lactations. Up to date 616 calves have been born (315 bulls and 301 heifers), and 164 bulls, 122 cows and 28 calves have been issued for breeding purposes in the districts.

Hosur is a cattle-breeding station and all the calves are allowed to suck their dams in order to encourage early maturity. The calves receive 6 to 8 lb. whole milk per day plus concentrates and fodder. The cows are all milked out fully one day per week and that milk yield is recorded for the week ; the calves on that day are hand-fed with milk. On other days, the surplus over 8 lb. is milked out and the calf is allowed to suck its dam afterwards. For example a cow yielding 12 lb. in the morning and 10 lb. in the evening, 8 lb. in the morning and 6 lb. in the evening is milked out and the calf is allowed to suck the rest.

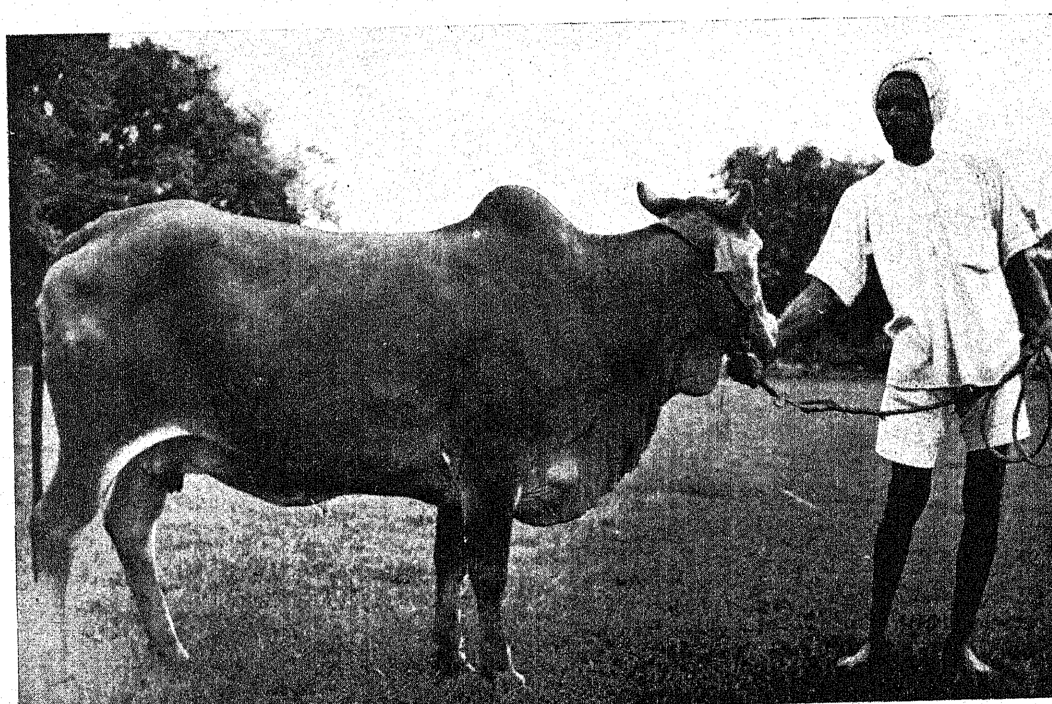
A large number of farm-bred cows are first calvers and their performances should improve in later lactations ; so the present comparison is not really favourable for them.

Improvement

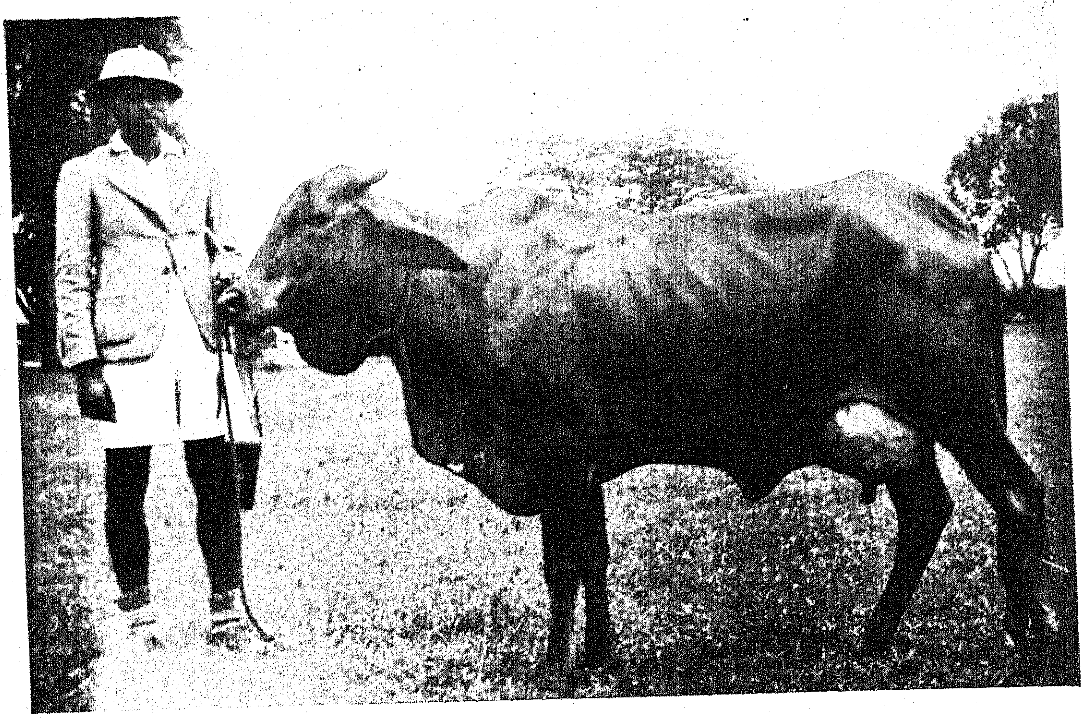
Comparing the performances of the present cows in the herd with those originally purchased, it is noticed that the 38 foundation cows averaged 4·8 lactations as against 2·8 lactations in the farm-bred herd of 58 cows ; the latter have not reached their best. The average yield of the farm-bred cows per lactation works out to 4,652 lb. with a daily average of 13·3 lb. as against 3,293 lb. and a daily average of 11·3 lb. of the foundation



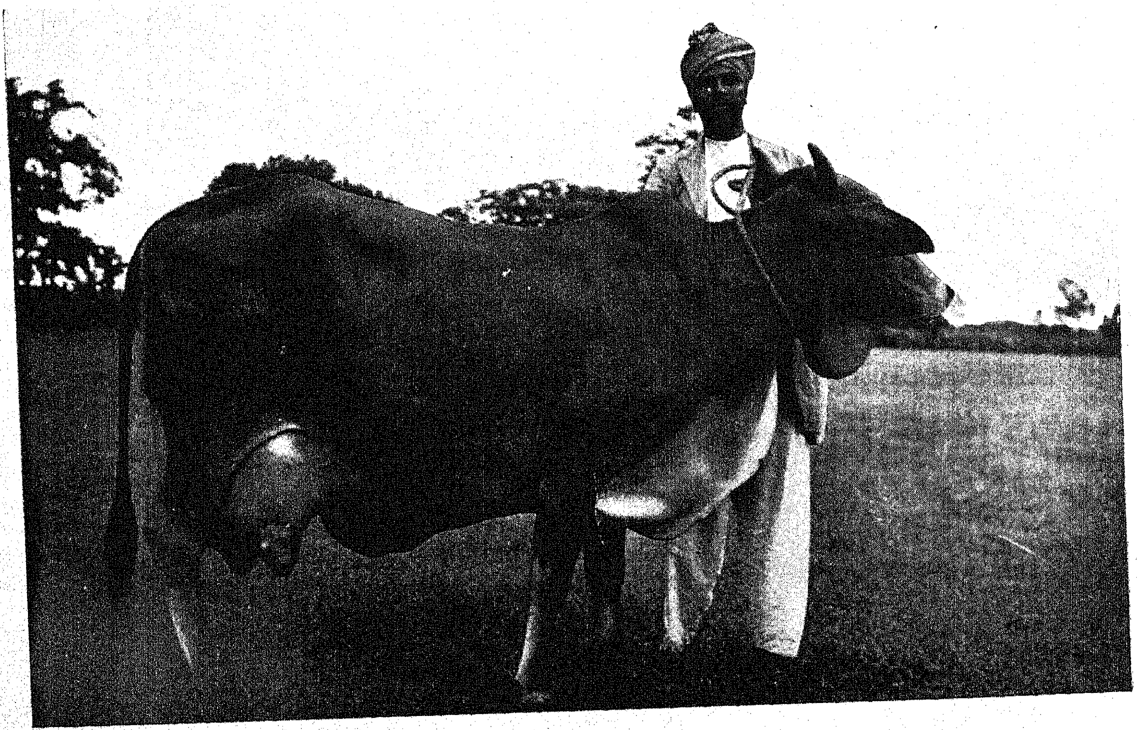
Cow no. 33. Age 11 years 3 months
Average yield for 5 lactations 5426 lb. Daily average 14.5 lb.
Maximum yield 6,695 lb. Daily average 17.0 lb.



Cow no. 121. Age 5 years 4 months
Milk yield 7,223 lb. Daily average 15.8 lb.



Champion cow no. 143. Aged 4 years 3 months
10,074 lb. milk in 366 days. Daily average 27.5 lb.



Cow no. 132. Age 4 years 10 months
Milk yield 7,824 lb. Daily average 18.9 lb.

cows. This is an increase of 1,359 lb. milk per lactation and 2 lb. milk per day per cow and works out to 41 per cent and 17 per cent respectively. The average number of days dry for the farm-bred cows is 161 days as against 220 days for the foundation cows—a decrease of almost two months.

The average weight of heifer calves at birth is 42 lb., the highest weight being 70 lb. and the lowest 27 lb.; the average weight for bull calves is 46½ lb., the highest weight being 69 lb. and the lowest 30 lb.

The average age (for 174 heifers) at which heifers take the bull is 2 years, 5 months and 17 days. During the last two years, 50 heifers have taken the bull at the average age of 2 years, 4 months and 10 days and of these 26 were below 2 years, 4 months. Ten heifers have taken the bull under 2 years old, the youngest being 1 year, 8 months and 27 days.

The record cow for this herd is cow 143—a first calver. She yielded 10,074 lb. milk in 366 days with a daily average of 27·5 lb. She was yielding 20 lb. per day at the time she was dried off. Another good cow is 132 which gave 7,824 lb. milk with a daily average of 18·9 lb. She has calved again and has yielded up to date 5,234 lb. of milk with a daily average of 37·4 lb. and is still giving 33 lb. per day. Her maximum per day was 40 lb. She is likely to yield over 10,000 lb. in this lactation.

Maximum yields

Studying the maximum yields of the cows at present in the herd, it is seen that 47 cows have yielded over 4,000 lb. milk and 13 cows over 6,000 lb. milk in a lactation.

Over 10,000 lb.	1 cow
Between 7,500 and 8,000 lb.	3 cows
„ 7,000 and 7,500 lb.	3 „
„ 6,500 and 7,000 lb.	2 „
„ 6,000 and 6,500 lb.	4 „
„ 5,500 and 6,000 lb.	2 „
„ 5,000 and 5,500 lb.	8 „
„ 4,500 and 5,000 lb.	12 „
„ 4,000 and 4,500 lb.	12 „

Cow 132 has produced the record daily yield of 40 lb. milk in her present lactation.

There is a good demand from the planters in the hills for Sindhi bulls for grading up the cows belonging to the estates and the estate coolies and the progeny of these bulls are a decided improvement on the local cattle and are greatly prized by the coolies. It is hoped that these tea estates will eventually produce good milking cows for milk supply to large towns in South India. Bulls of this breed are also in demand in urban areas where a good supply of milk is required.

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EXPERIMENTAL HAND PLOUGH

The hand plough is used at the Botanical Sub-station, Karnal, mainly for sowing small cultures and experimental plots, and it gives satisfactory results. The sown plots show very satisfactory germination and the plough is found to be an indispensable implement for experimental sowings. All *rabi* crops, viz. wheat, gram, barley, oats, linseed, flax and peas are sown with this plough.

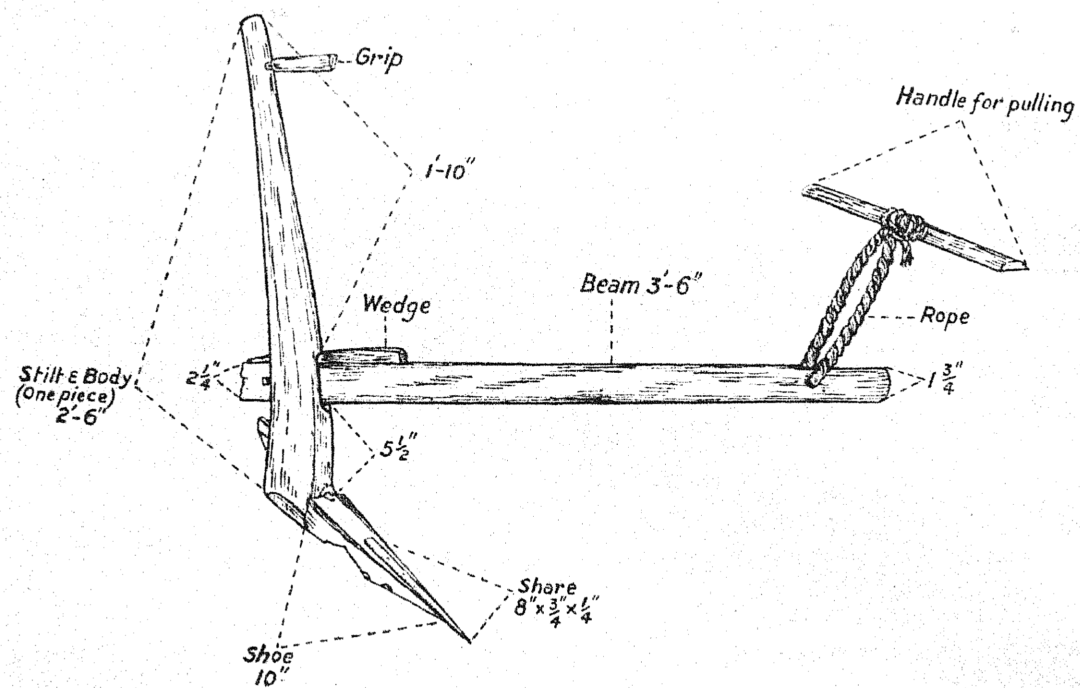
The stilt is one piece with the body. The grip end is about 4 in. in circumference and the body at its thickest part (where the shoe is mortised) is about 10½ in. in circumference. The cross-section of the piece (stilt and body) is nearly oval.

The beam or the draft pole is mortised into the body and is 3 ft. 6 in. long. It is 2¼ in. broad, and 1 in. thick at the body end and gradually tapers towards the other end, where it is almost oval and is about 4½ in. in circumference. About 4 in. to 5 in. away from this end, a hole is bored for attaching the rod for pulling with a rope.

The shoe is mortised in the body at an obtuse angle and is 10 in. long from its toe to the point of insertion in the body. The heel end projects about 4 in. beyond the body and is firmly secured by a wedge. The upper surface of the shoe is about 4½ in. wide at its point of insertion into the body and gradually tapers to a point at its toe.

The share is an iron piece about 8 in. long, ¾ in. broad and ¼ in. thick. It gradually tapers to a fine point and is nailed to the shoe. It protrudes beyond the toe of the shoe by about 1 in. to 1½ in.

The stilt and body piece is made of *babul* (*Acacia arabica*) and the beam usually of a



lighter wood such as teak, etc. The share is the only iron part used in construction of the plough. The plough weighs 7 lb. It could be manufactured by any local carpenter at an approximate cost of about Rs. 4 to 5.

I A R I DIPLOMA

MR P. R. Bhagwagar, M.Sc., (Alld.) has been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after the completion of the two-year postgraduate course in Mycology and Plant Pathology commencing from November, 1938 and the acceptance by the Institute Council, of his thesis entitled

Part I—*Review of* Fungicides *in India (including Burma and Ceylon)*

Part II—*Studies in* Fusarium *wilt and seed-rot of gram* (Cicer Arietinum *L.*) *in India*

Part III—Alternaria *species on potato in India.*

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q : What are the chief insect enemies of lac ?

A : There are two groups of enemy insects which attack lac crops. These are parasites and predators. The parasites are small winged insects resembling wasps and are called Chalcids. They lay their eggs inside the lac coat either in or on the body of the lac insect and the young ones of these feed on the lac insect only and not on lac produced by it. The damage done by this class of enemies varies from 5 to 10 per cent.

Predator damage is far more serious, the two insects mainly responsible being *Eublemma amabilis*, Moore (the white moth) and *Holcocera pulverea*, Meyr. (the blackish grey moth). The damage done by the larvæ of these insects amount to about 35 per cent of the lac cells. The larvæ of these insects feed both on the lac insect and the lac produced by it.

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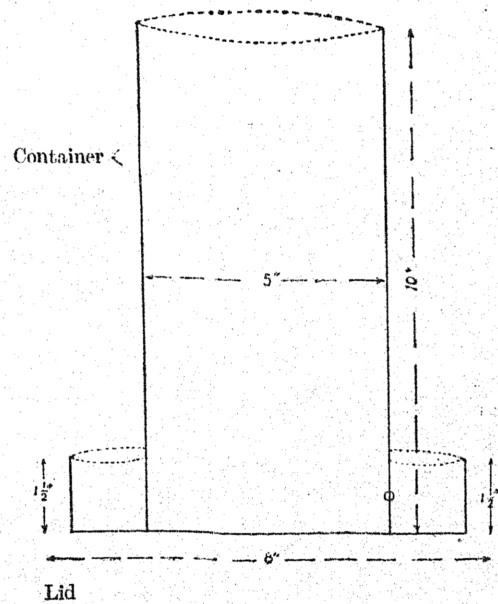
Q : Can you recommend a suitable design of a drinking vessel for a domestic fowls' pen ?

A : An ample supply of fresh water is essential for all classes of fowls. The water is usually fed in two kinds of drinking vessels, open vessels (as buckets, pots and pans) and closed vessels of the fountain type. The open vessels made of tin, iron or earthenware are more common than the fountain type. Open vessels for adult birds are very satisfactory and they should be sufficiently large to provide ample water for at least 12 hours to all the birds. The water in all containers should be renewed every morning and evening after cleaning out the containers. The vessels should be placed in a shady place to prevent the water becoming too warm which renders it unpalatable and encourages the growth of micro-organisms. Some poultry-keepers cover the water vessel with an earthen pot which has an aperture to allow the birds to drink but prevents birds fouling the water with their excreta or feet.

The fountain type of container is as given in the figure.



Water container

The container and lid can be made of tin or any other suitable material. The container is filled with water and inverted over the lid and the water, until used up, rises in the lid to the level of the hole in the container but does not rise above the level owing to the atmospheric pressure keeping up the water in the container. This type of container is very suitable for young chicks as it prevents contamination and safeguards against drowning.

Q. Since the fodder grown on soils deficient in phosphoric acid keeps the animals in a reduced condition, can sterilized bone-meal be used as a cattle feed both for milch animals and working animals? If so, what is the proper dose and how should it be administered?

A: There is a likelihood that fodders grown in areas where the soil is low in available phosphorus may be deficient in this mineral and thus may cause malnutrition in animals. The most efficient way of removing the difficulty is to apply phosphatic fertilizers and to improve the general quality of the fodder. Sterilized bone-meal can be used to correct the deficiency of phosphorus, if any, in both milch and working animals. The approximate dose is one ounce per day for average cattle, given mixed with the concentrate mixture. With very high-yielding animals, 2 oz. can be given.

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Q: As a hide-merchant, I lose a considerable amount of money owing to the existence of holes in the hides I collect. Would you please let me know how the damage is caused and whether it can be prevented?

A: The ox warble-fly, a serious pest of cattle in this country, is responsible for the damage of which you complain. This fly, which is about three times the size of a common house-fly, lays its eggs during the summer months on the leg hair of animals. Each fly is capable of laying up to 500 eggs. These eggs hatch into minute larvæ which, after boring through the skin, wander about in the different body tissues of their host, until, in early winter, they reach the back, where they cause the so-called warble tumours. Each larva then bores a hole through the hide in order to get out to the air to breathe. When well developed, the larvæ are barrel-shaped and measure nearly $\frac{3}{4}$ inch in length and $\frac{1}{4}$ inch in breadth. At this stage they squeeze themselves out of the tumours through the holes they have made and fall to the ground, where they remain in the form of pupæ for from 6 to 8 weeks. The flies that emerge from these pupæ begin their life-cycle over again. They have only one brood in a year.

As you are aware, a 'warbled' hide is depreciated in value according to the number of holes present. It has, indeed, been estimated that this pest alone is responsible for a loss of nearly Rs. $1\frac{1}{2}$ crores a year to the Indian hide industry.

A considerable amount of research on the control of this pest has been carried out at the Imperial Veterinary Research Institute, Mukteswar. It has been found that the best remedy is the application of larvicidal dressings on the tumours during the winter months. A very effective dressing of this kind is a proprietary derris preparation obtainable, in India, from Messrs Mousell & Co., Mercantile Buildings (P. O. Box 2164), Calcutta, at Rs. 2-8 per lb. Four ounces of this powder mixed in one quart of water makes the required wash. One gallon of this wash is enough to treat about 48 head of cattle at a cost of less than an anna per head.

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Q: I have read that *amla* (*Phyllanthus emblica* Linn.) is a very rich source of vitamins. Is this true?

A: *Amla* is very rich in vitamin C, the vitamin which prevents scurvy. It contains only traces of other vitamins. It is the best natural source of vitamin C so far discovered, containing from 5 to 7 mgm. of the vitamin per gramme of fresh pulp. A medium-sized *amla* fruit yields as much vitamin C as two oranges. The fresh juice contains ten times more vitamin C than orange juice, lime juice, or tomato juice.

When *amla* fruits are pickled in concentrated salt solution they retain a good deal of their vitamin C even after storage for several months.

What's doing in All-India

BOMBAY

By B. S. PATEL, N.D.D., N.D.A., C.D.A.D.
Principal, Agricultural College, Poona

A NEW feature of propaganda introduced under deamalgamation of the Rural Development Department since January 1941 is the observance of the official demonstration day and farmers' week in all districts and on all Government Farms.

Officers' day

Successful demonstrations were held on the Officers' day and farmers' weeks on 6 January and 10 February and the weeks subsequent to those dates on the Dharwar and Ratnagiri Farms respectively. Numerous demonstrations were staged to show the cultivators the crop improvements, the control measures against crop diseases and insect pests, method of tillage by improved implements and poultry farming. The variety of the questions asked by the visitors showed that some of the new crops like the new Jayawant cotton, dry Napier grass, lucerne, pineapple and methods of grafting, etc. appealed to them. The announcement by the Collector of a grant of Rs. 2,000 sanctioned for side grafting with Alphonso scions on the old country mango trees which abound on the coastal belt as well as the interior was received with great enthusiasm.

The cultivation of onions was introduced in the coastal tract of the Kanara district as a second crop after paddy. The recent rise in the price of onions has given a good stimulus to the extension of its cultivation. The area has gone up to about 800 acres, with a fairly satisfactory yield enabling farmers of Kumpta and Honavar to export onions instead of importing them.

Coconut pest

The coconut leaf-eating caterpillar was unknown in the Bombay province for a time, although it was common in South India, Ceylon, Bengal and Burma. In 1922, a terrible outbreak of this destructive pest took place at Mangalore in South Kanara, and it played such havoc in the coconut gardens that had it not been for the prompt action taken by the Madras Government with the enforcement of the Pest Act, several of the gardens would have been ruined.

This pest was first noted in a coconut garden at Ratnagiri in 1930. It is not possible to say how the pest came to be introduced all of a sudden. No reports about the seriousness of the pest have been received so far from this locality.

The first report of a serious outbreak was received in 1938 from a place called Uttan in the Thana district. This is situated on the sea coast near Bassein, about 25 miles to the north of Bombay. The pest has also been noted in other places in the Bombay suburban area and recently also in Goa.

Damage done

The pest in question is a small moth known to the scientific world as *Nephantis serinopa* Meyr. It is small and ashy grey in colour. It lays its eggs in batches on the underside of leaves. The caterpillar is greenish in colour with pinkish longitudinal lines on the body with a black head. It constructs around itself a silken gallery in which pieces of chewed fibre and excreta are incorporated. When fully fed the caterpillar pupates in a tough oval cocoon built of silk in a part of the

gallery. The pest breeds throughout the year.

The caterpillars gnaw the underside of leaves, leaving only their upper epidermis which soon dries up. The infection starts from the lowermost ring of fronds and spreads upwards. From a distance the infested trees appear as if they have been scorched. Besides coconut trees, the pest also attacks brab or toddy (*Phoenix sylvestris*).

The pest can be controlled by spraying with a stomach poison like lead arsenate, but considering the height of the trees and the cost of the operation this does not seem to be a practical proposition. Cutting out infested fronds as soon as the pest appears and burning them is the only practicable measure. People are afraid that the trees might die as the result of the treatment, but none of the treated trees in any of the private gardens in which they were in any way cared for has died in spite of the fact that 50 per cent or more of the fronds had in some cases to be cut. The cost of the operation works out approximately to about 18 palms per rupee.

This method will, however, succeed only in case it is adopted by all the cultivators in an infested locality, and with this end in view the Madras Government had to enforce the Pest Act. Neglect to carry out these measures fully in the initial stages may lead to disastrous results.

Medium-stapled cotton

Khandesh and Nasik districts of the Bombay Province grow short-stapled NR cotton. The cotton-breeding station at Jalgaon in this tract has evolved by selecting in Verum cotton a strain which is far superior to NR in quality and which is found more paying to the cultivators. It is named Jarila as its white shining lint resembles *jari* (silver lace). Its staple is $\frac{7}{8}$ in. long against $\frac{4}{8}$ in., and it spins 30 counts against 7 counts of NR. In fact, introduction of Jarila in place of NR means growing medium-stapled cotton in a short-stapled tract. NR is susceptible to wilt, whereas Jarila is wilt-resistant. The district trials of this cotton attracted the attention of the cultivators and a seed multiplication scheme financed jointly by the Bombay Government and the Indian Central Cotton Committee was launched by the Agricultural Department in 1937. This scheme was an ambitious one and was intended to cover 600,000 acres in five years. Its working, however, was not satisfactory in 1939 and 1940, and the progress made was very limited. In 1940, which is the fourth year of the scheme, the stipulated area to be covered with controlled pure seed was 155,000 acres but the actual area was hardly 40,000 acres. The Director of Agriculture had an intensive tour in this tract recently and desired that all possible attempts should be made to reorganize the work. The main defect was that seed growers in later stages sold their produce to petty merchants, and *kamgars* appointed under the scheme were not able to follow it up for separate ginning. The seed areas were organized on a taluka basis without due consideration for marketing centres or gins with the result that bonds executed by the seed growers for returning the seed of their produce remained unenforced.

Conditions for success

For successful working of the seed multiplication scheme, it is necessary to organize seed areas round marketing centres and pool together the produce for sale with a condition to the purchaser to gin it separately and stock the seed; or to induce the seed growers to gin their produce separately and sell lint. The Deputy Director of Agriculture and the Cotton Superintendent visited all the cotton marketing centres in these districts and reorganized the whole work. Arrangements have been made through approved agents and cooperative societies to stock pure Jarila cotton seed sufficient for 150,000 acres and to organize 49,000 acres seed area in different stages during the coming season. The prices of Jarila cotton ruled high during this period and they helped the propaganda to a considerable extent. With this reorganization of work it is expected that the area under controlled seed will go up to 300,000 acres in 1942, 450,000 acres in 1943 and 600,000 acres in 1944. The present scheme ends in 1942 and its extension for three years is under

consideration.

Agmark for pure cotton

A scheme for agmarking 1027 ALF cotton to the standard of not less than 97 per cent purity financed by the Bombay Government and the Indian Central Cotton Committee was in progress during the last quarter ending 31 March 1941. As 1027 ALF and 1A cottons are competing in the Surat district and as Surti, Deshi and BD8 are also found as mixture, the *kamgars* appointed under the scheme were trained to detect these mixtures in fields and were sent out with detailed written instructions for marking the mixtures with different coloured rags so that their work could be easily checked by the graduate agricultural officers appointed under the scheme. The Cotton Superintendent and the Deputy Director also toured the district and checked their work and certificates were given only to the cotton which is pure to the standard of not less than 97 per cent purity. This work, which has been very thorough, has revealed that 1027 ALF cotton is pure to the extent of 99 to 100 per cent in places where pedigree farm seed is grown for seed purposes in the third stage. In the later fourth stage, it is 98 to 99 per cent pure. In the general area the purity of the crop varies, but only that which has come to the standard of more than 97 per cent purity is certified for agmarking. The total area inspected is about 20,000 acres. Ginning and pressing of certified cotton under the agmark is now in progress.

Measures against sugarcane pest

The grasshopper has been the only serious pest on sugarcane on the Deccan Canals, particularly on the Pravara and Godavari Canal areas. About 4,000 acres were affected last season, but there was no damage to the crop, due to timely and prompt control measures taken by the staff appointed under the grasshopper control scheme. The scheme has now been extended by Government for three years. Vigorous propaganda has been carried out for the following preventive measures which were found successful against grasshoppers during the last few years so that there should not be any further multiplication of the pest.

(1) To dig out all the outside *bunds* and the sides of inside *bunds* of the affected fields in order to destroy the egg-masses of grasshoppers which are mostly situated there, before the end of May so that those that are not destroyed are exposed to the sun and allowed to dry.

(2) To plough up about 300 ft. area surrounding the affected sugarcane crop and destroy the exposed egg-masses before the end of May.

(3) To keep all the *bunds* and the surrounding fallow area clean of weeds.

(4) To interculture the ratoon crops of the affected sugarcane area and carry out properly the operations of *khod-chalni* before the monsoon.

(5) No hot-weather irrigation should be taken for any crop in affected areas unless the lands are properly ploughed up.

(6) *Pachat* should be spread and burnt on the affected area when ploughing is not possible.

(7) Not to ratoon the affected sugarcane crop.

(8) To plant the cane as *adsali* (half-yearly) or early in October or November which is less affected by the pest.

(9) To shift the plantation of sugarcane from an affected to a non-affected zone or not to plant any sugarcane in the affected area for a couple of years.

(10) The staff consisted of (1) Divisional Superintendent of Agriculture, Deccan Canals, (2) Agricultural Overseer, (3) Agricultural Sub-Overseer and (4) Four *mukadams*.

Effective propaganda

The methods of propaganda consisted of (1) approaching individual cultivators and advocating the necessary preventive measures and getting them done whenever convenient, (2) distributing leaflets through Revenue and Irrigation Officers, and (3) meetings. Of these methods the first, viz. approaching the individual cultivator, is the most effective.

UNITED PROVINCES

By C. Maya Das, M.A., B.Sc. (Edin.), I.A.S.
Joint Director of Agriculture, United Provinces, Lucknow

An important scheme of potato development is now in operation in the Kumaun Hills. The local varieties of potatoes having degenerated on account of mosaic infestation, it became difficult to get disease-free seed for planting in the plains. A good way has been found of supplying healthy seed for planting in the plains of the United Provinces for the October sowings. Potato plantings are done in January and February in the valleys of the Kumaun Hills. The crop is harvested during May and June and after a resting period of three months the seed is made available for sowing in the plains in October. The scheme has been in force for the last three years and has led to some improvement of the potato industry both in the hills and on the plains. Two improved types, namely Dunbar Cavalier and Majestic, were imported from Scotland and are being successfully grown in the hills.

Distribution of potato seed

Two cooperative unions at Bhowali and Garampani took up fairly large-scale distribution of potato seed to the plains. In an average year, between 2 to 3 lakh maunds of hill potatoes go to the plains. An appreciable percentage of this consists of seed potatoes. It is the intention of the Department to provide seed for the plains through cooperative bodies. This will prevent excessive profiteering by middlemen at the various markets and centres through which the potato passes on its way from the hills to the plains and the seed will be available at cheaper prices to the cultivator.

The engineering section of the Department of Agriculture constructed five large tube-wells of five inches and over, giving a discharge of 300 gallons per minute. Seventy-seven tube-wells were in course of completion and 15 projects for tube-well construction were about to be taken in hand. The large tube-wells are meant to command over 100 acres of land each.

The improvement of masonry-well supplies by boring is one of the most important activities of the engineering section. Small borings in existing or proposed masonry wells produce continuous and adequate supplies. Some 294 such wells have been attempted during the quarter and out of these 234 have been successful. In the eastern districts which have neither the benefit of canal irrigation nor of state-constructed tube-wells, the need for improvement of masonry-well supplies is pressing. The Government have been fully alive to this need and have initiated a five-year rural development scheme for boring and sinking pipes in masonry wells in the eastern districts. The main object of the scheme is to increase agricultural production by supplying adequate quantities of irrigation water to the cultivator and to protect him from drought in years of scanty rainfall. This is the third year of the rural development scheme and during the quarter 101 wells have been bored successfully out of 106 wells attempted. The total subsidy given by the Government towards the boring of these wells during the quarter amounted to Rs. 6,590.

Design of implements

An *ad hoc* committee which was appointed to go into the question of design and manufacture of agricultural implements, met at the Agricultural Institute, Allahabad, and some of the important conclusions arrived at are given below:

1. Abandonment of the Akola hoe in favour of cultivators of the Planet Junior type.
2. Popularization of the finally standardized Olpad threshers among the cultivators.
3. Encouragement of the Praja plough devised by the Department and the Shahbash plough devised by the Agricultural Institute, Allahabad. Both these ploughs are of the light-draught type.
4. Encouragement of the Cawnpore plough of the Victory type and the U. P. plough No. 2

of the Allahabad medium-to-heavy-draught type.

5. Investigation of the possibilities of combining the functions of the cultivator and the harrow in one implement.

6. The relative economics of the different types of Persian wheels to be studied and further improvements, if any, in gearing, bucket-bearing chain and water-splash to be investigated.

Two caterpillar tractors, one of 40 h.p. and the other of 50 h.p., were used in mechanical cultivation on contract for zemindars and also for tobacco cultivation at the Government Agricultural Farm, Bharari. With the Diesel 50, 168 acres were ploughed 6-8 in. deep, 474·5 acres were harrowed and 93 acres were rolled, while with the Diesel 40, the respective figures were 45·5, 243 and 165·5 acres.

The following implements were manufactured in the Agricultural Engineer's workshop and distributed to the cultivators through agricultural assistants :—

Akola hoes	205
Planet Junior cultivator	26
Karhas	23
Olpad threshers	48
Gurjar Meston ploughs	11
Victory ploughs	88
Praja ploughs	111

Cotton research plan

Research on the improvement of cotton, wheat and barley is being conducted by an Economic Botanist who also holds charge of a scheme for the improvement of Bengal Cottons in the U. P. The scheme is financed by the Indian Central Cotton Committee. A scheme for research on barley is also under his charge and is financed by the Imperial Council of Agricultural Research. Cotton research is conducted at Cawnpore, Raya, Nagina and Belatal. The entire work includes collection of suitable indigenous and exotic cotton varieties and their selection and breeding.

The cotton crop generally grown in the province consists of a mixture of varieties popularly known as ' U. P. Bengals '. Its staple is short and coarse, capable of spinning only up to 8 standard warp counts, but it has a fairly high ginning percentage. In order to isolate the desirable characteristics of the mixture, a field survey of the crop was carried out and suitable selections were made between 1933-39. These selections are now under various stages of test. The breeding trials of the field survey selections involved detailed examination and purification of the material by replicated tests. While some of the earlier selections have reached the stage of final trial, the material collected later is being studied at different stages of purification. As improvement by the method of simple selection had a limited scope, artificial hybridization between different vatieties was adopted in order to combine the desirable characteristics of the two parents. The hybridization work which started in the last week of August comprised the crossing of the three improved varieties of U. P. cottons, i.e. C 520, C 402 and Perso-American with other standard types of cottons obtained from outside the province. The programme has been based primarily on the demand of the local mills which require a cotton spinning up to at least 22 counts, though earliness and resistance to insect pests and diseases is also taken into consideration when selecting the progeny.

C 520, a selection from the indigenous roseum type, is the most popular variety in these provinces. It has been exported to Kathiawar (Baroda) and parts of Central India and Rajputana. It is a high-yielding early variety and fetches a premium of 8 annas per maund over the *desi*, but as it spins only up to 12 counts, it falls short of the requirements of the cotton mills. Crossing work is being done in order to increase its spinning value to 22 counts without eleminating its other good characteristics.

C 402, a cotton of hybrid origin has a staple length of 4/5 in. and spins up to 22 counts, but unfortunately it lacks in hardiness and earliness. In order to overcome these defects it has been crossed with C 520.

Perso-American, as its name indicates, is an American type of cotton originally obtained from Iran (Persia) and acclimatized in the U. P. It possesses the desired characteristics of good yield and long staple, but requires a little more improvement in quality and resistance to boll-worm and leaf roller, which are rampant in these provinces. In order to

introduce genes for these characters, it has been crossed with better quality disease-resistant American cottons. With the object of evolving high yielding, good quality and wilt-resistant strains by a method of simple selection, certain extractions from C 520 and the more promising strains of the survey material were sown in a highly wilt-infected field at Raya. Strain C 520/9 seems to possess a high resistance to wilt infection.

Malting tests on barley

Research on barley is carried out at Cawnpore, Raya, Nagina, Belatal and Gorakhpur. The experiments include a study of fresh collections from indigenous and exotic barleys, varietal tests and agronomic trials involving cultural practices, manurial problems and rotational effects. Malting tests and selection and breeding work are also carried out. From the last year's crop 118 samples of barley were sent to the Imperial Agricultural Research Institute, New Delhi, for malting tests. Smaller quantities of these samples were sent to the Muree and Solan Breweries for hand valuations. On receipt of their malting report, 15 of the best samples were selected and sent to the Institute of Brewing, London, for obtaining confirmatory test reports.

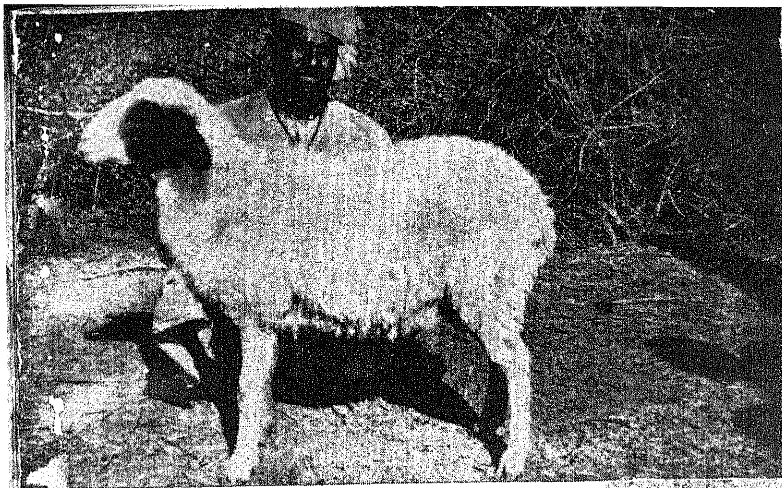
The Economic Botanist in charge of oil-seeds, millets and fibre has found that *arhar* strains C46 and C79 evolved by him at Cawnpore are good in yield and are also resistant to disease. The latter characteristic is being further studied in wilt-infected soil. The smaller millets—*sawan*, *mandua* and *kodon*—were studied both on the plains (at Cawnpore) and in the hills (at Tarikhet). All the hill varieties of *sawan* proved to be rather late at Cawnpore. The hill varieties of *mandua* failed at Cawnpore, the plants becoming yellow and diseased soon after germination. Similarly the varieties from the plains did not behave normally in the hills and generally fruited prematurely. Higher yielding selections of *jowar*, *bajra*, maize and the smaller millets have been retained for further study.

Points of Jalaun sheep

An experimental sheep farm was opened by the Veterinary Department at Bodhpura, Orai (Bundelkhand), in April 1939, on 229 acres of land. The objects of the farm are to breed sheep which may eventually improve wool-carrying capacity, to determine the stage to which crossings can be carried out without deterioration of the breed, to find the best time for shearing, to teach a better method of shearing, wool classing, combing, carding and weaving to the sheep breeders and to investigate sheep diseases in collaboration with the Imperial Veterinary Research Institute, Mukteswar.

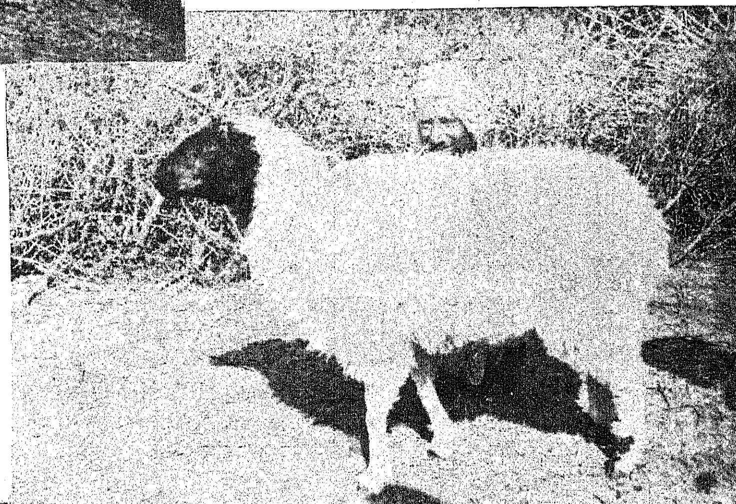
The white variety of sheep found in the Jalaun district is being crossed with white Bikaner sheep imported from Rajputana where the climatic conditions are similar. The Jalaun white sheep is hornless, coarse-wooled, with or without tan and black markings round ears, eyes and face. It has a square head, long ears, measuring 6 in. $\times$ 3 in., a somewhat broad forehead, tapering face, fairly large nostrils and moderately thick lips. The head and legs and the under-surface of the neck and abdomen are covered with coarse hair. The Bikaner sheep bears a resemblance to the Jalaun type in some respects, but is a larger and better-wooled animal with a shorter face and ears. A large percentage of the ewes have black heads. The rams of both types show the same difference in characteristics as the ewes. No definite conclusions can be drawn as yet about the effects of cross-breeding between Bikaner and Jalaun sheep, but the first strain of the cross between Bikaner rams and Jalaun ewes shows an improvement in the quality and quantity of wool (plate 108).

The local shears, which are worked with both hands, clip too high and leave furrows which cause an unnecessary wastage of wool. The English claw-shaped type of shears is used on the farm and has given the best results. Another type of shears from the Punjab which looks like an oversize pair of ordinary scissors has also given good results compared with the long type of shears used by the local breeders. The Industries Department will help to demonstrate improved methods of combing, carding and weaving to the local sheep breeders so that they may be able to get a better price for their wool.



Left : Jalauni ewe

Right : Bikaneri ewe



Below : Jalauni ram : Bikaneri ram

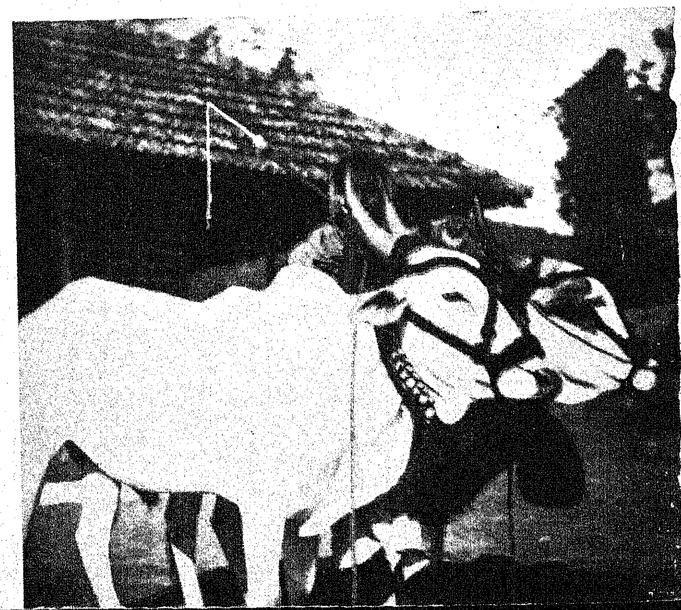
ght : Jalauni lamb : Bikaneri bred

Kulgunda Cattle Fair

This cattle fair is held annually in Subramania village, a place of pilgrimage in South Kanara district. It is one of the biggest fairs held in South India, and is a very important one for the ryots of this district because it is the chief centre from where they obtain their cattle. Most of the cattle that attend the fair come from the Mysore State and none belong to South Kanara. The fair reached its peak seven years ago when about 50,000 cattle attended it. The source of cattle supply to the ryots of this district is supplemented by herds brought into it from Mysore State periodically during the year by cattle dealers.

The best quality of bullocks for cart and ploughing are the Mysore breed, and their prices vary from Rs. 100 to Rs. 300 per pair. He-buffaloes are of the Hassan breed and their prices range from Rs. 40 to Rs. 120 per pair. She-buffaloes are the Krishnagiri variety and their prices vary from Rs. 40 to Rs. 100 each.

PLATE 109]



BIHAR

By B. P. Akhaury, B.Sc. (Wales)
Deputy Director of Agriculture, Patna

During November, a big cattle fair was held at Sonepore. This is the largest cattle fair of the province. The Department of Agriculture has a permanent demonstration block where exhibits are displayed and explained to the farmers.

Along with this, application of manures, working of implements, South-Bihar sugar making, poultry and beekeeping are demonstrated. Popular lectures with lantern slides and loud-speakers on agricultural subjects are given. The Department also organizes a cattle show, first started in 1937, in which local breeds of cattle are displayed and two or three prizes in cash are awarded to the best exhibits in each breed for (i) bullocks, (ii) cows in milk, (iii) dry cows, and (iv) bulls. Each year it gains in popularity, and it is hoped it will be one of the main features of the Sonepore fair.

Rural development

Five community halls, two new primary schools and one *panchayat ghar* have been constructed by voluntary effort. New village roads of the approximate length of 4½ miles were constructed and 11½ miles of old roads repaired and dressed. Two new *pucca* wells and six *kacha* wells were constructed, while 24 old wells were repaired. A number of demonstration plots were arranged with the help of the Agricultural Department. Sixty-one new panchayats have been formed and 89 new mass literacy centres were opened. The *charkha* has been introduced and cotton is being grown to provide cotton for spinning.

A special feature is the uplift work started by the Rural Development Department in Saran district among the criminal tribes. Stress is being laid on meetings every night in Manbhum district. In Singhbhum one blanket weaving loom and four *tasar* reeling machines have been introduced. In one village a rivulet has been *bunded* up and turned into a water reservoir for irrigation. In Bhagalpore, Motihari and Hazaribagh an elaborate inquiry into economic and social conditions has been undertaken and is nearing completion.

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Animal welfare

The cultivators and the educated classes are taking interest in the welfare of their cattle, for which the services of the veterinary assistant surgeons are requisitioned, whenever there is an outbreak of cattle disease. The veterinary assistant surgeons were able to secure public cooperation in inoculations against contagious diseases, castration of scrub bulls and treatment of disease. One case of glanders was detected and the infected pony was destroyed. Some of the district boards are taking an interest in cattle-breeding and maintaining stud bulls at dispensaries of the veterinary assistant surgeons for free service of village cows.

Besides the veterinary hospitals, there are a number of field dispensaries which the veterinary assistant surgeons attend on different week days to treat or inoculate the animals against rinderpest, haemorrhagic septicaemia, anthrax, blackquarter. The cultivators are now more and more in favour of such protective inoculations. Castration with Burdizzo's castrator is now becoming popular and 930 castrations with this instrument were done in one district in three months.

Introduction of flax

Flax, which is the same botanical species as linseed, is now being grown in Bihar at some of the Government farms on an experimental basis. The difference between flax and linseed is that the former is grown for fibre to be extracted from its stalk and the latter for oil to be extracted from its seed. Flax is poor in its oil-content but produces fibre of very good quality.

Flax is important due to the demand for its fibre for the production of war materials. As about 70 per cent of Britain's requirements were produced in European countries now cut off by war, it is very important to find places where flax can be grown successfully to make up the total quota of Great Britain's requirements. In north Bihar, where the soil and climate seem to favour this crop, seed multiplication has been started at the Government farm, Pusa.

MYSORE

By M. Vasudevamurthy, B.Ag.
Secretary, The Mysore Agricultural and Experimental Union, Bangalore.

A SEASONS' experience with the first colony of agriculturists started in the Irwin Canal area has developed an optimistic outlook for further projects in this direction. A second colony is now starting and a third one is under contemplation. The first attempt began with just ten colonists, whereas 20 candidates have been selected for the second colony. The inability of young men to furnish a sum of Rs. 1,000 in hard cash has been sympathetically viewed, and they are permitted alternatively to offer the security of two eligible persons or that of property of double the value or of Mysore Government securities of the same value as the loan to be advanced to the colonist by the Government. The concession thus shown is correlated with a smaller acreage of irrigated land given to the colonist and an advance of Rs. 750 by the Government instead of Rs. 2,000. But that is in the line of extending the benefits of colonization to a greater number of young men than would otherwise be possible. The economics of the holdings to be brought out by the accounts that each colonist must necessarily keep according to terms would be very interesting. More than a hundred young men applied for land in the second colony, affording an answer to the suggestion made in the Government Order that if the response is satisfactory a similar colony may be started near Marconhally in the Tumkur district.

Paddy receives more attention

A five-year plan of work concentrated in the large paddy areas of the state has been taken up. A special staff of 21 agricultural inspectors has been appointed so that the ryots may be acquainted more speedily with all the improvements suggested by the Agricultural Department. The problem of paddy is important in the agriculture of the state. Paddy is cultivated over more than 700,000 acres and yields obtained with special strains are of such a high order that they indicate a fair scope for a general improvement. Considerable work has been done at the Paddy Breeding Station at Nagenhally and in trying out new varieties here and there all over the state: the step now taken is an advance in sequence.

Cotton in new areas

Similarly a concentrated scheme of cotton cultivation is launched in the Maddur and Malavalli talukas, *i.e.* the tracts fed by the distributaries of the Irwin Canal, in a zone away from the sugar factory at Mandya. Experiments have already indicated that the red loamy soils of the state can be thrown open for cotton, that these soils are specially suited to long-stapled cottons and that these cottons do particularly well under irrigation; also the cotton mills in Mysore have found long-stapled samples from the Irwin Canal Farm answering their requirements. Thus it was in the nature of things that the possibilities of the scheme came under the deliberations of a Cotton Development Committee comprising of the Director of Agriculture, the Director of Industries and Commerce, the Superintending Engineer of the Irrigation Division and the representatives of the cotton mills. It is hoped that the ryots will not miss the addition to their cropping system of a crop likely to make their agriculture more than ordinarily remunerative.

Donations to veterinary hospitals

The report of the Civil Veterinary Department shows that quite a number of philanthropic gentlemen are donating fair sums of money to put up good buildings for veterinary dispensaries and hospitals. The gradual spread of veterinary aid has helped to deal with epidemics more effectively than before and this has been reflected in some energy released for other livestock problems. That the public are with the workers in all this development is indeed encouraging.

The stationing of pedigree bulls at the veterinary hospitals to improve the breed of cattle in the locality has always been on the programme and some sort of apportioning of costs between the Government and local bodies has been a limiting factor. It is now proposed to distribute free of cost to each municipality one good stud bull which will be stationed at the veterinary dispensaries. Twenty-five municipalities have already come forward to maintain the bulls.

Statistics collected now and again serve to indicate the natural spread of improvements advocated among the cultivators. Thus a counting made by the veterinary inspectors reveals that about 1,671 Hallikar and 206 Amritmahal bulls are maintained in the state for stud purposes, that 265 cross-bred rams have been maintained in 141 villages and that improved poultry has developed in 379 villages.

AGRICULTURAL ECONOMICS

RURAL reconstruction was the theme of the presidential address by Sir T. Vijayaraghavacharya, K.B.E., to the second conference of the Indian Society of Agricultural Economics held at Lahore on 12 and 13 April. In its widest sense rural reconstruction, he said, includes all that a Government can do to ensure prosperity in rural areas, and particularly every effort it can make to redress the balance between town and country. In a slightly narrower sense, it includes all those activities which tend to increase the health and the income of those who live in villages and isolated homesteads, whether through the increase of facilities like education, communications, irrigation, credit and justice, or through the provision of particular assets like wells and schoolhouses, or through subsidy of one kind or another or through measures to check the operations of adverse forces, as in legislation for the relief of debt.

Need for Coordination

The best work appears to have been done in countries where the cooperative society served as a link between the will to self-help through honesty and industry of the individual and the special knowledge and ability of outside experts. In the Punjab, the United Provinces and Bombay, the aim is to bring the efforts of the specialist departments to a focus in the village society by coordinating the policies of the departments at the centre and the activities of their officers in the districts and multiplying village societies of a suitable constitution and adequate enthusiasm. In many provinces there is a need for the greater coordination of expert departments, particularly those 'development' departments which are immediately concerned with the welfare of the agriculturists. This coordination is secured either by the appointment of a single officer or of a committee.

Role of Cooperation

The appointment of 'village guides' to serve as a link between the rural population and the officers of development departments has been advocated. The proper organization to awaken the enthusiasm and mobilize the energies of villagers is the cooperative society, if activity can be voluntary, and the panchayat if a minority has to be compelled in the interest of the villagers as a whole. There is no need to multiply cooperative societies: joint work, joint responsibility and joint security are the contributions of cooperation to village welfare, and they can be secured for various purposes by a single organization. The business ability of the villager being limited, there should be paid secretaries for the larger societies, and village guides for every village. There is a great variety of useful enterprises which the societies can undertake, but there is no reason why a society should not make a wise choice

of activities and gradually develop them into enduring improvements.

Agricultural overpopulation

There are a number of outstanding problems which have to be tackled. The first is that several provinces suffer from a deficit of food crops. It is necessary for example to make the rice-eating provinces self-sufficient in respect of their food supplies without giving up industrial or money crops. This is possible through scientific research, intensive farming, improved seed, increased manure, extension of area under cultivation and new irrigation projects. One result of the increase in population (probably 400 millions at the recent census) is increased pressure on land for cultivation purposes. Most provinces suffer from agricultural overpopulation. Remedies suggested are emigration, industrialization, subsidiary industries, nationalization and agricultural colonization. The chief difficulty in colonization schemes is the want of definite knowledge about the extent and nature of the land fit for agriculture, but still unoccupied.

Another aspect of the rural problem is cattle insurance. Both from the point of view of cattle products and cattle labour, cattle are of great importance. The amount of capital invested in cattle is considerable and the ryot who loses his cattle by disease or other misfortune is frequently unable to replace them. One of the ways to provide against cattle mortality is insurance. The experiment in cattle insurance in Madras in 1919 was a failure. In Burma, out of 219 societies on paper, only six were active in 1938. Cattle insurance is one of the most difficult forms of cooperative effort. Firstly, statistics relating to cattle mortality are necessary to assess the actual premium rates, but they are not available. Secondly, the ryot should keep the animals well and in good condition. The average quality of cattle is poor and insurance of cattle is not worth while except in the case of pedigree stock, but in their case too the risk of loss through disease is great. Thirdly, there should be an organization for the prevention and control of contagious diseases, and veterinary aid should be easily accessible and properly regulated. The insurance of cattle cannot be worked satisfactorily through private enterprise in existing conditions: the state alone can attempt a venture of this kind even as an experimental measure.

Problems discussed

Khan Bahadur M. Afzal Hussain was the chairman of the Reception Committee and extended a welcome to the delegates and members of the Society. The Hon'ble Sir Manohar Lal, Finance Member in the Punjab Government, inaugurated the Conference. A number of papers discussing rural problems such as the place of the village artisan in India's rural economy, cooperative marketing of agricultural products, the necessity of a producers' organization for developing the ghee trade in the Central Provinces, agrarian banking in India, moneylending legislation, factors affecting the price of rice, the war and agricultural prices and crop planning were read and discussed. A special feature of this conference was that a number of prominent agriculturists and literate grantees took part in the proceedings.

The next Conference will be held in Poona during the Christmas holidays. An executive committee consisting of the following was then selected:

President: Sir T. Vijayaraghavacharya
Vice Presidents: K. B. Mian Afzal Hussain
Dr Sam Higginbottom
Dr P. J. Thomas
Honorary Secretary: Mr S. K. Bedekar
Honorary Joint Secretary: Dr M. B. Ghatge
Members: Dr E. D. Lucas
Dr A. I. Qureshi
Dr B. K. Madan
Dr R. K. Mukherji
Dr T. G. Shirname
Sardar Sahib S. Kartar Singh
Mr D. R. Gadgil
Prof. J. S. Guleri
Prof. I. M. Kapur.

The Month's Clip

MUCK AND MAGIC

THESE animadversions are prompted partly by a booklet[1] that we have received for review, and partly by an article by Sir Albert Howard that appeared in *The Countryman* and was reprinted in the *East African Standard* of 11th October, 1940, together with a review, by Major E. S. Grogan, of a book entitled *An Agricultural Testament*, also by Sir Albert Howard.

Major Grogan writes that this book 'is merry stuff, and should set the beehive humming'. Well, then, let this bee hum.[2]

There would seem to be four main schools of thought on this subject of compost. Firstly there is the old-fashioned farmer (and an increasing number not so old-fashioned) who has always believed that 'muck is the mother of money' but has not entirely accepted the doctrine of the virgin birth of money. Secondly, there is Sir Albert Howard and his disciples who, while making supernatural claims for the value of muck, eschew supernatural aid in manufacturing it. Thirdly, we have the authoress of the booklet sent us for review, though we fear that she is merely a backslider from the fourth school, that of the Anthroposophists.

Let us consider these four schools in somewhat greater detail, but in reverse order, beginning with the most esoteric, the Anthroposophists.

It is impossible in a few words to outline all the peculiar tenets applied by Anthroposophists to agriculture, but the main points appear to be as follows: All life, animal and vegetable, is dominated by 'etheric formative forces'. These forces are both cosmic and terrestrial, the former occurring in fire and air, the latter in earth and water. (These, it may be noted, are the four 'elements' of the medieval alchemists.) They emanate from the stars, the soil, insects, and from a host of other things, and somehow or other become condensed in certain plants, from which it is possible to extract them provided the correct magical rites are known. These rites include such processes as tying the plants between the horns of a cow, and exposing them to the influence of their appropriate planet. Any land will grow excellent and disease-free crops if, but only if, treated with manure or compost produced on the land itself and activated by infinitesimal doses of these occult preparations. It is not permitted to compensate for produce removed from the land by adding any fertilizer, whether organic or artificial, brought in from outside, and pest control is prohibited. The character and temperament of the cultivator are of great importance, and all his operations must be done at the propitious phase of the moon.

Much of this mumbo-jumbo has been discarded by the authoress of *From Vegetable Waste to Fertile Soil*. There is no mention of astrology or cows' horns, and in fact the booklet starts with a reasonably sound and simple method of compost-making. If it began at page 13 (as it does) but finished at the top of page 18 instead of on page 64, there would be little to criticize except the price of 2*s*. 6*d*.

But it goes on to emphasize the necessity of 'accelerating' the compost by the addition of certain herbal 'essences' and honey in what can only be described as super-homœopathic doses. Thus three-quarters of a drop of six mixed 'essences' and one-eighth drop[3]

[1] *From Vegetable Waste to Fertile Soil* (*Quick Return Compost System*) by Maye E. Bruce, London, C. Arthur Pearson, Ltd. 64 pp. 2*s*. 6*d*.

[2] Since this was written, several bees have hummed in the *East African Standard*, which reprinted, on 25th October, an article from *The Countryman* containing the views of Dr Popplebaum (one of the Queen Bees of Anthroposophy) and the criticisms of Sir John Russell, Sir Daniel Hall and Prof. R. C. Wood. No doubt before this is printed buzzing will have been begun by Pyramid prophets and the Pluviolunatics. (We are not being rude—it means the rain-moon experts.)

[3] A drop is about one minim; the final concentration of all the 'essences' (which are themselves largely composed of rain water) is therefore approximately 1 in 20 million parts of manure.

of honey is sufficient for a heap that will produce one ton of compost, and it is even stated that an excess will cause the compost to go bad.

The formulæ for these 'essences' are not secret like those of the Anthroposophists, but are freely given, together with pseudo-scientific reasons for their efficiency. Thus camomile is one of the six 'essences' because it contains potash, lime, phosphorus and sulphur. No doubt it does, for all plants contain them, but imagination boggles at the quantity of these substances that one-eighth of a drop of camomile juice can add to a ton of compost.

Compared with all this nonsense, Sir Albert Howard at first sight appears to be, as the Red Queen said, as sensible as a dictionary. No one will question that, as (in Major Grogan's words) the Apostle of Humus, he has rendered invaluable service. But like so many apostles, he attributes very much more to his god than the god ever dreamt of attributing to itself. Let us examine just one or two of his exaggerated claims. He says that a healthy plant, grown on soil rich in humus and without artificial manures, will be practically free from diseases and pests, and therefore entom-, myc-, bacteri- and other ologists, not to mention chemists and statisticians, can go on the dole.

Consider the silkworm, Sir Albert; it may not toil much, but it certainly spins, at least when fed on healthy vigorously growing mulberry leaves. Do you really believe that silkworms thrive best on sickly mulberry trees? Yet the silkworm is no less of a pest from the point of view of the mulberry bush than the cutworm is from the cultivator's. You say that the floor of the forest is to be regarded as the ideal factory of humus. How then comes it that the loss from insect pests of forest trees, in the U. S. A. alone, for the one year 1936 was estimated at $130,000,000?[1] Or that during the first quarter of the present century, millions of acres of the magnificent forests of American chestnut in the eastern United States were annihilated by the chestnut blight, a fungous disease introduced from Asia?[2]

[1] *Destructive and Useful Insects*, Metcalf and Flint, 1939.

[2] U.S.D.A., *Year Book of Agriculture*, 1927.

Of course, Sir Albert is, as often, partly right. There are many insects that only attack seriously an undernourished or otherwise weakly plant. This is true of many wood-borers and some scale-insects. But there is an even greater number of pests that thrive in proportion to the vigour of their host plant—most, if not all, leaf-eating insects, and the sap-sucking plant bugs. In short, his main thesis is, in Major Grogan's words, that 'a healthy plant, and consequentially healthy beast can only derive from a healthy home.' But where is there any essential difference between the antestia and the aphis (which we happen not to want) and the silkworm and the sheep (which we do want)?

Again, Sir Albert states that artificial manures 'supply nutirents for the green leaf only. They are therefore unbalanced.' One is tempted to think that his knowledge of artificials begins and ends with nitrate of soda. For there is much truth in the saying, even though its expression may be somewhat unscientific that 'Nitrogen makes foliage, Phosphorus makes roots and seeds, Potash makes sugar and starch.'

Lastly, what is the commonsense view? A soil rich in humus is less affected by drought, it is easier to prepare a good tilth and to keep it in 'good heart', and it is less liable to erosion, than an equally fertile soil the fertility of which depends entirely on artificial manures. Apart from these very considerable benefits, farmyard manure and compost return as much of the crop as possible to the land, if the residue was wasted, a greater expenditure on artificials would be essential to maintain fertility. On the other hand, artificial manures make it possible to return to the land those elements of fertility removed from it by any particular crop.

But even though we agree that, on the whole there is 'nothing like muck' and that it is 'the mother of money', it is no less true that exaggeration is often the father of reaction, and many a good cause has been hindered rather than helped by making extravagant claims for it.

We might briefly mention a fifth cult, that of the Hydroponicists. These assert that the best crops are grown not only with-

out organic manures or compost but also without soil, in water to which the necessary salt solutions are added. Aquiculture (surely a better word than Hydroponics) is perfectly sound scientifically, and indeed is no new thing but it seems unlikely that it could ever replace ordinary methods of agriculture, except perhaps for the production of fresh vegetables in large cities or at aeroplane stations in desert countries. A debate between an advocate of Hydroponics and an Anthroposophist should prove highly entertaining.

But perhaps we have entirely failed to grasp the inner meaning of Anthroposophical agriculture. That it aims at replacing science by magic is certain. It is no less certain that its adoption would result in a decline in production. It purports to have originated in Germany. But did it? Is it not more likely that its purpose is to undermine the agricultural economy of the hardworking and peace-loving German people, and that in reality it emanated from the perverted brain of Mr Winston Churchill? T. W. K. —The East African Agricultural Journal, Vol. VI, No. 3, January 1941.

* * *

SOIL EROSION

SERIOUS damage and loss from water erosion occurs during the autumn, winter, and spring to unfrozen soil in the ploughed lands and after hoed crops, even when the land is not fall ploughed. Wherever there is a slope, small streams and rivulets form during heavy rains or when the snow melts rapidly; these quickly form water courses and small gullies, which, if not checked, soon form deep gullies that have to be filled before the crops are planted again. The greatest loss, however, is not noticeable and consists of the fertility carried away in solution or in the small soil particles that make the water muddy, states J. A. Clark, Superintendent, Dominion Experimental Station, Charlottetown. Some believe that much more fertility is lost in this way than is added by all the commercial fertilizer bought each year by our farmers. This represents many hundreds of thousands of dollars.

The following autumn control measures are suggested:—Steep hillsides should be reforested or left in grass. When broken they should be ploughed in strips across the hill or along contour lines. It is usually best to plough sod even on moderate slopes, across the hill instead of up and down. It is true that the fibre roots of sod prevent washing, but wherever water moves over soil it dissolves out or carries valuable soil particles away.

Stubble land ploughed early and land where hoed crops have grown can be ridged along the contours of the slopes to prevent water erosion. Recent trials at the Charlottetown Experimental Station indicate that fall rye or winter wheat sown in September or early October is one of the best control measures against water erosion.

Single furrows carefully run across the slope to slow up the flow of surface water are beneficial. Stubble, trash and brush can be used across wherever small streams and gullies may occur, to slow up the flow of water, since the carrying capacity of water is greatly increased by the rate of flow. By watching the fields during heavy rains and freshets and by diverting the run of water from all steep slopes with a shovel, loss of time and valuable fertility may be saved.

Growing plants is nature's way of holding soil fertility. Diverting the flow of surface run-off from slopes, will greatly reduce the loss of soil fertility by erosion.—*Press Note, Dominion Department of Agriculture, Canada.*

* * *

HOW PLANT BREEDER AIDS CROPS

RESEARCH on crop production is one of the important phases of the work of the agricultural scientists of Canada. Man improves upon nature, not only by careful management of the soil, but also through the selection of the seed or stock from which the crop is produced. Modern practices require that seed must be pure, free from diseases and insects, and of high vitality. Regulations regarding the grading and distribution of seed are based upon careful research work, confirmed by field trials, and finally drafted into laws that are administered by the Dominion Department of Agriculture.

More fundamental than the appearance and vitality of the seed, however, are the inherited factors carried in the germ of the seed. The natural law of the survival of the fittest produces hardy strains of plants whose main characteristic is their ability to survive, and not their usefulness to man. The plant breeder takes the most useful strains that have been developed by natural selection, and by artificial selection he improves the yield and quality of the crop. The botanist searches Canada and other parts of the world for suitable hardy varieties to form the basis of improved varieties; the geneticist (the scientist who deals with the life, heredity, and variation of the plants), and the cytologist (scientific expert in the cell structure, functions, multiplication, and life-history) study the factors of inheritance that may be transmitted by these strains, and combine them with existing domesticated strains to produce improved varieties. The great diversity of climate in Canada makes it necessary to have many varieties capable of producing satisfactory crops under varying conditions of soil, temperature, light, and moisture. A variety that may prove highly desirable in one area may be quite unsuitable in another.—*Press Note, Dominion Department of Agriculture, Canada.*

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BULL PENS & EXERCISING YARDS

A good bull pen and exercising yard is a sound investment for a dairy farm. With strong and convenient accommodation, bulls can be handled to a greater age without any danger.

Some farmers prefer to have the bull pen in the cow stable for convenience in feeding and handling the bull in winter. There are some disadvantages, however, in this arrangement, states Alan Deakin, Division of Animal Husbandry, Central Experimental Farm, Ottawa. One is the fly problem in summer, unless the pen is cleaned out daily. Another is that in order to have an exercising yard an outside door to the pen is necessary. Unless this is kept in good repair and well fitted, too much cold air gets into the stable during winter. Another disadvantage is that most barns are so situated that an exercising yard of sufficient size cannot be made to run off conveniently from any part of the stable.

An outside shed with an exercising yard is the most satisfactory way of housing a bull. The shed should be strongly built on a concrete foundation, with a small feed room at one end and preferably a loft for hay or straw. A slide door is convenient for closing during cold and stormy weather, and also for closing the bull out when the pen is being cleaned out. The fence around the exercising yard has to be strongly built. A breeding chute with a gate can be made at one side. With all these conveniences a bull does not have to be handled.

Some bulls become troublesome by breaking the exercising yard fence. With such a bull a cable can be strung out from the pen and the bull tethered to it through the nose ring and a chain long enough to allow the bull to lie down. However, bulls rarely exercise themselves much when tethered to a cable. One way of overcoming the use of a cable is to put a strand of electrified barb wire just on the inside of the fence. Where several bulls are kept, a single strand electric fence has proven sufficient as an inside fence to keep bulls separated from each other. Sometimes a good big log thrown in the exercising yard serves as a means of exercising a bull and prevents him from ruining the fences. If gravel or sharp cinders are kept in the exercising yard the bull's feet will be kept in better shape and need not be trimmed, or at least so often.

Plans of a bull pen and exercising yard can be obtained from the Animal Husbandry Division, Central Experimental Farm, Ottawa, Ontario.—*Press Note, Dominion Department of Agriculture, Canada.*

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MATURITY OF TOBACCO

OVER a period of years experiments have been conducted by the Dominion Experimental Farm Service at Harrow, Ontario, concerning the maturity of tobacco, writes R. J. Haslam, Assistant Superintendent. The conclusions drawn from these experiments indicated that timeliness of operation is exceedingly important in the normal process of

maturity. For instance, a delay in the preparation of plant beds, seeding and transplanting tended to throw each successive operation such as topping, suckering and harvesting out of its normal season, consequently affecting both the yield and quality of the crop.

Well hardened, sturdy seedlings have always been found important in starting the tobacco crop satisfactorily. If some preparation is made during the fall and winter months, such as necessary repairs to plant beds and also securing of plant bed soil, less delay is likely to occur in spring operations. Timely operations in regard to transplanting are important, but each successive operation is equally important and must follow in due season.

From results of experiments relating to time of planting with topping and harvesting operations, it was found that late planting usually resulted in late topping. Furthermore, postponement of topping until the plants had reached an advanced stage in flowering definitely delayed the normal process of maturity. Topping at the proper time allowed not only for better development of the top leaves but also for a more uniform ripening of the whole plant. Delayed topping extended the harvesting season into more hazardous weather conditions for curing. This is important regarding air-cured tobacco, particularly cigarette Burley which is normally sensitive to weather conditions at time of harvesting and curing.

Postponement in suckering also had a direct bearing on the normal process of maturity. Plants suckered regularly developed larger leaves throughout the entire plant than unsuckered plants. The tobacco from these plants ripened earlier and was much superior in quality to the leaf from the plants suckered less frequently. This would indicate that large suckers tend to rob the plant of certain necessary properties that may assist not only in ripening but also in curing of tobacco.

The type of soil, cultural and fertilizer practice, and the weather conditions prevailing during the growing season also are known to be influencing factors regarding the normal process of maturity in tobacco. Nevertheless, if the procedure to be followed between transplanting and harvesting is timely in its application the tobacco crop will tend to improve rather than to deteriorate in value.—*Press Note, Dominion Department of Agriculture, Canada.*

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WINDBREAKS MEAN TREES

EVERYONE has experienced the comfort of a windbreak on a cold windy winter's day. It is enough to say that the sheltered areas seem very much warmer than the wind swept ones. Such shelter around the farm buildings would seem to be a necessity, states E. T. Goring, Dominion Experimental Station, Kapuskasing, Ontario.

How can this shelter be built up? The only practical method is by planting trees. Broad belts of trees planted on the sides from which the prevailing winds blow stop the icy blasts and maintain in their lee a calm in which life can be lived in comfort.

Trees differ in their value for this purpose. Evergreens are the best. They present the greatest resistance to the passage of air and thus stop it most effectively. Unfortunately they are slow growing and take some years to provide shelter.

Deciduous trees such as poplars grow quickly but offer less resistance to the wind. They will be quite satisfactory if planted in a broad enough belt. Perhaps the best windbreak can be made up of a mixture of trees such as spruce and poplars. By alternating the trees in the rows and staggering the rows, effective protection can be built up in a comparatively short time. The quick growing short lived poplars give early protection. When they reach maturity and begin to die, the slower growing evergreens are ready to take their place. No matter what the conditions are, some trees can usually be found to suit them. —*Press Note, Dominion Department of Agriculture, Canada.*

New Books and Reviews

Our India

By Minoo Masani (Oxford University Press, 1940, pp. 166, Rs. 2-12)

EXCEPTIONAL gifts have contributed to the writing of this book. The author has collected interesting facts about India and presented them in a lively, picturesque, conversational manner for Indian boys and girls. As he handles them, the dry bones of statistics live and economic facts are far from dismal. On every page is evident a burning love of the land, a vivid realization of India's tremendous resources and a firm belief that if the people will it the country's wealth can be utilized to promote national well-being. The illustrations are extremely well done. For instance, the representation of the livestock resources of the leading countries and their milk supply is so graphic that the lesson of India's inefficiency leaps to the eye. We see at a glance that Germany gets as much milk from 2½ crores of cattle as India does from 18 crores.

The book is a popular account of India's resources, actual and potential, and what can be done with them if they are rationally used. There is a lucid discussion of Indian agriculture, at the end of which the lessons of cooperative farming, increased irrigation, afforestation and manuring, use of modern implements and reduction of the cattle population are brought home to the reader. The modernization of agriculture would lead naturally to the displacement of labour from the land, and there follows a description of Indian industries old and new and their capacity for expansion.

A few inaccuracies may, however, be pointed out. Cowdung is not used to *pave* the floors and walls of villagers' huts (p. 47); the cultivators do not need to pull down fences to start cooperative farming (p. 89) because fences are conspicuous by their absence over the greater part of the countryside. Lastly, in the illustration on page 40 the cultivator setting to work sickle in hand has adopted a most unlikely pose.

Books such as these, attractively written and illustrated for young readers, are badly needed. Children cannot begin too early to realize what an immense field there is in this country for the application of science to everyday life and how best they can set about the task of making our India a rich, happy and prosperous country.

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Cooperative Farming

By S. K. Dey, I.C.S. (Published by Indra Dey, Collector's House, Nadia, Bengal, 1940, pp. 121, Re. 1)

THIS little book on cooperative farming gives an interesting account of an experiment recently started under the aegis of the Collector of Nadia. Cooperative farming has often been discussed at conferences of cooperators and there have been attempts to set up cooperative farms in several provinces. None of them has so far been a lasting success. For a year or two the work is carried on on the wave of enthusiasm created by some zealous cooperative worker or official and then either losses occur or faction starts again. After two or three years experiments have died a natural death.

One of the main reasons for failure is that there has been no striking gain in the wealth of those taking part in the scheme. Another difficulty has been in obtaining capital. It would be interesting to see how the Nadia experiment succeeds in overcoming these difficulties in the next few years.

The booklet has useful appendices showing the draft sale deed (which was the device adopted for the transfer of the cultivators' land to the management of the society), by-laws of the farming society and the cropping scheme and the budget. The by-laws are a model of simplicity and the report and

register-writing work which is the bane of many societies has been kept commendably short.

Considering the tenacity with which the cultivator sticks to the individual management of his land, it is extremely doubtful if cooperative farming unaided by legislative compulsion has possibilities of large-scale expansion; but these experiments have great value as they prepare the ground for suitable legislative action by bringing out the technical difficulties involved in the transition from individual management to cooperative management. [V. S.]

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The Rice Problem in India

By W. R. AYKROYD, B. G. KRISHNAN, R. PASSMORE and A. R. SUNDARARAJAN, Indian Medical Research Memoir (Thacker Spink & Co., Ltd., Calcutta, 1940, pp. 84, Rs. 3-8 or 5*s*.)

ABOUT the year 1923 Messrs Robert McCarrison and R. V. Norris studied the rice problem in relation to beri-beri and pointed out how in the processing of rice for the table considerable quantities of nutritive and protective constituents are lost. The present memoir supplies further information on the subject. The relation between the consumption of highly milled rice and beri-beri has been established. Numerous experiments and observations showed that beri-beri is caused primarily by deficient intake of the anti-neuritic vitamin B_1. The nutritive values and the defects of poor rice diets have been studied in this book from many angles. Their deficiencies and remedies are fully discussed. The objective metabolism of carbohydrates of diets deficient in vitamin B_1 where the ratio of vitamin B_1 to calorific value is less than 0·250, is brought about by defective absorption of pyrubic acid which accumulates in the blood and in the nerve-centres, bringing about neurosis. The administration of vitamin B_1 restores the normal metabolism where the damage has not become irreparable.

The diets deficient in vitamin B_1 are almost invariably deficient in other essential dietary elements and this predisposes the persons to an attack of beri-beri when the intake is on the border-line of nutritive requirements. The relation between the vitamin B_1 requirements and the caloric intake explains why hard manual work requiring high energy expenditure predisposes one to beri-beri. The loss of vitamin B_1 during the process of preparing rice from paddy has been estimated in various stages of manufacture. Comparative studies on hand-milled and factory-milled rice have given results to the disadvantage of the latter. The loss of pericarp and embryo in the factory removes with it most of the vitamin B_1. Further losses during washing of rice and cooking, when water in which the rice is boiled is discarded, have also been estimated. This process involves some loss of vitamin B_1.

The values of raw milled rice and parboiled rice as regards vitamin B_1 contents have been studied and the relatively high content of vitamin B_1 and nicotinic acid of the parboiled rice as against raw milled rice is considered sufficient to remove the rice diet from the danger zone of vitamin B_1 deficiency.

Thus the superiority of parboiled rice and the absence of beri-beri in localities where it forms the chief article of diet finds a scientific explanation.

The rice diet is further deficient in calcium, vitamin A and other accessory factors of vitamin B_1 and its supplementation with milk or calcium lactate has been found to be very beneficial. It will be interesting if the values of *dahi* (fermented curds) and of *matta* (fermented buttermilk) which are used extensively by rich and poor are investigated. Some benefits are derived by inclusion of pulses in the dietary. The partial substitution of rice by millets can improve the nutritive value of the diet.

The socio-economic aspects of the milling problem are also studied. This indicates the lines on which future development may be directed.

The scope for breeding and evolving rice varieties of superior nutritive value has been under-estimated and the effect of judicious manuring has not received attention. The variation in vitamin B_1 contents of rice from different localities is appreciably large and if this had been looked into further interesting

data might have been brought out. [B. V. N]

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Agriculture in Uganda

By the Staff of the Department of Agriculture, Uganda. Edited by J. D. Tothill, D.Sc. (Oxford University Press, 1940, pp. xvi+552, 20s.)

As the editor has pointed out in the Introduction, this book endeavours to describe the state of agricultural knowledge and advancement in the Protectorate of Uganda in 1937, though many references have been given regarding work done and conditions obtaining in the earlier pioneer years. It is essentially a departmental effort compiled from original contributions by the officers of the Uganda Department of Agriculture, and the individual authorship of each article is given. The book is divided into 22 sections and sets forth a vast array of very useful information connected with almost every topic of agricultural interest concerning Uganda. It contains a scientific account of soil and climate, descriptions of the cultivation and disposal of the various crops and a discussion of such problems as soil conservation, maintenance of soil fertility and measures necessary to obtain a high standard of yield and quality in the cotton crop. It also provides comprehensive accounts of agricultural conditions and individual crop industries including local food supply in the Protectorate. The general get-up of the book is excellent and it is illustrated. It will certainly be found useful and interesting by Indian readers. [S. C. R.].

From all Quarters

KING'S BIRTHDAY HONOURS

THE King's Birthday Honours list includes certain names connected with service to agriculture and animal husbandry:

To be Members of the Order of the British Empire

Francis James Gossip, Esquire, Livestock Expert to the Government of Bengal.

Rai Bahadur

Rai Sahib Jai Chand Luthra, M.Sc. (Pb.), D.I.C. (Lond.), F.R.H.S., Indian Agricultural Service, Professor of Botany, Punjab Agricultural College, Lyallpur.

Dr Swarna Kumar Mitra, M.S. (Calif.), Ph.D., Director of Agriculture, Assam.

Rao Bahadur

Rao Sahib Khubchand Issardas Thadhani, Director of Agriculture, Sind.

LET'S BE SIMPLE

A NUMBER of scientific papers dealing with a vital problem in East Africa have recently come my way, and I know their author hopes others will use his results and apply his conclusions. But they won't—of that there is no doubt—simply because no one who is not a combination of an expert riddle-solver and a calculating machine can possibly understand what he writes. Yet what he has to say is really quite easy to understand, and would go right home if only he would stop saying the simplest things in the profoundest language and muddling his readers with masses of quite unnecessary mathematics.

'The degree of human contiguity, C, is significantly and positively correlated with the contentment index, C^1, of the population in question ($r_{cc1}=+{\cdot}9999\pm{\cdot}00001$; $P<{\cdot}002$)' may mean to some, 'The more we are together the happier we shall be,' but it certainly doesn't to most; so why say it like that if you want people to understand? Yet that is the sort of thing we constantly have to read, and it is small wonder that so little comes of it.

Statistics are being used (and abused) more and more by people who seem to forget that although they are a useful tool they are a dashed confusing toy, especially in the hands of those scientific children who have only just come by their new plaything and frequently forget that what comes out of the mathematical machine can in no wise mean more than what goes into it.

It is like making sausages. If bad meat goes in, it is still bad when it comes out, if there is too little of it, you won't get all the sausages you hoped for. And so it is with any mathematical process. If you put in dud data, your final answer will be dud, even if it *is* clothed in a lovely intellectual-looking sausage skin decorated with symbols, borrowed from the Greek alphabet.

The object of any scientific writing is, or should be, to explain things to others. If you do that you succeed, and the best way of doing it is not to strive after erudition nor to aim at impressing the world with what you know (or think you know), but merely to state the facts as simply as you can. The work will be all the sounder for it. It is simply amazing how much rot passes muster when clothed in verbiage.

The other day I set about paraphrasing a very involved paper on nutrition. The effect was startling. Half of it proved to be purely platitudinous, and I found myself writing such pearls of wisdom as, 'The more food they get the less hungry they are.' Is it really worth while printing stuff like that at any time, let alone when paper is precious?

At the other end of the scale there are men, acknowledged experts in various branches of science, who write so delightfully simply that even those who know scarcely anything about the subject can understand their works. They are the sort of scientific writers we need in East Africa, the only sort whose work will be applied. Let's have more of their kind. Let's be simple. A. T. Culwick in *The East African Agricultural Journal*, April 1941.

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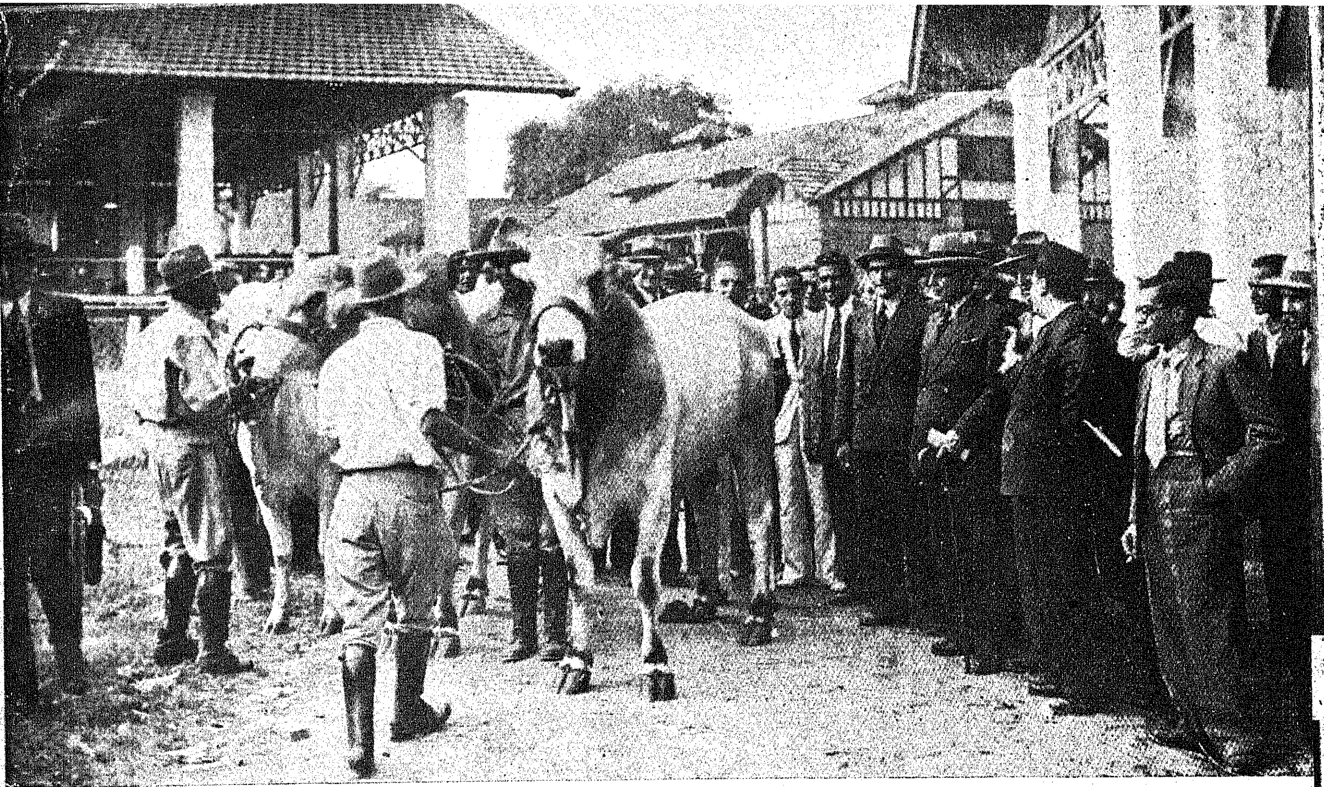
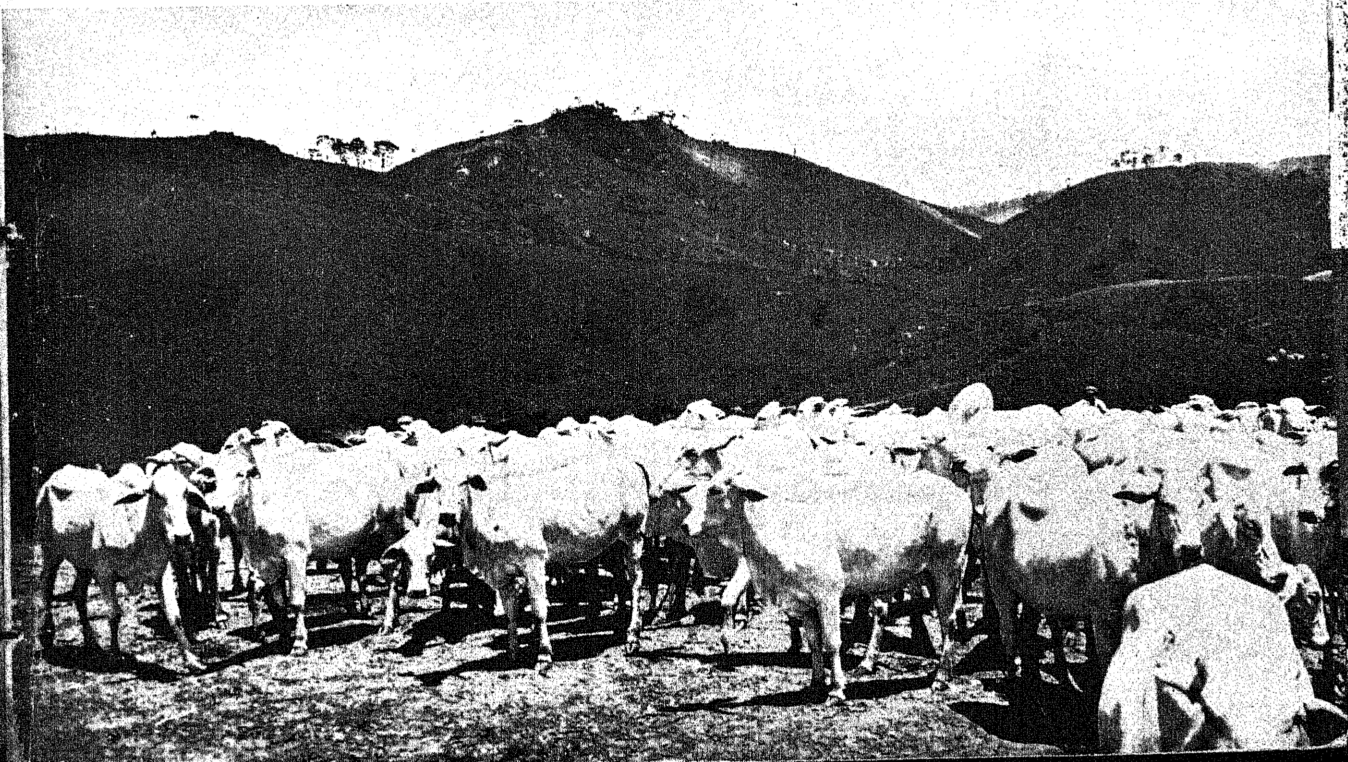
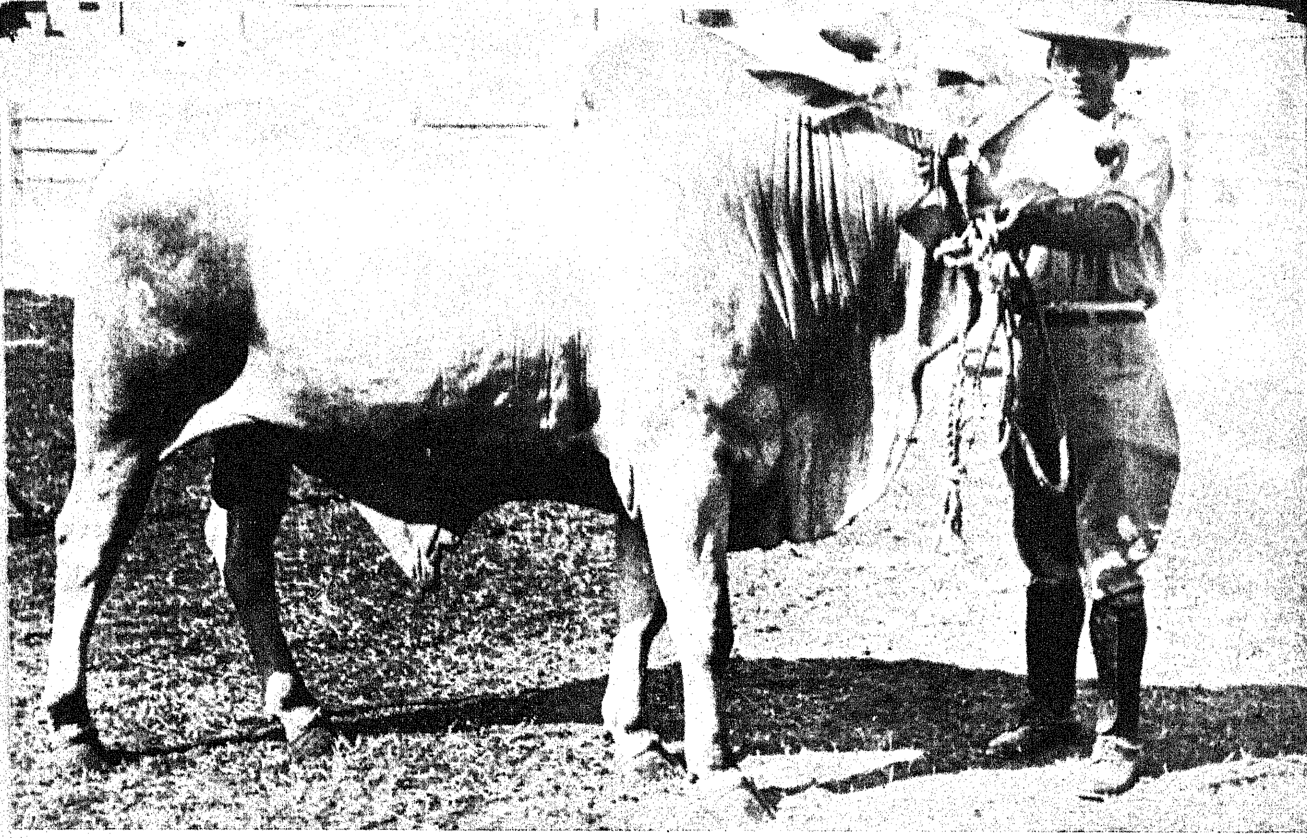


Fifth National Show of Animals, 1936
Visit of Dr Odilon Braga, Minister of Agriculture and Dr Landulpho Alves, Director of the D. N. Produccad Animal Society at the Show, Fazenda Indiana.

Pure-bred calves of the Nellore (Ongole) breed. Bred and owned by Pedro Marques Nunes, Fazenda Indiana

[PLATE





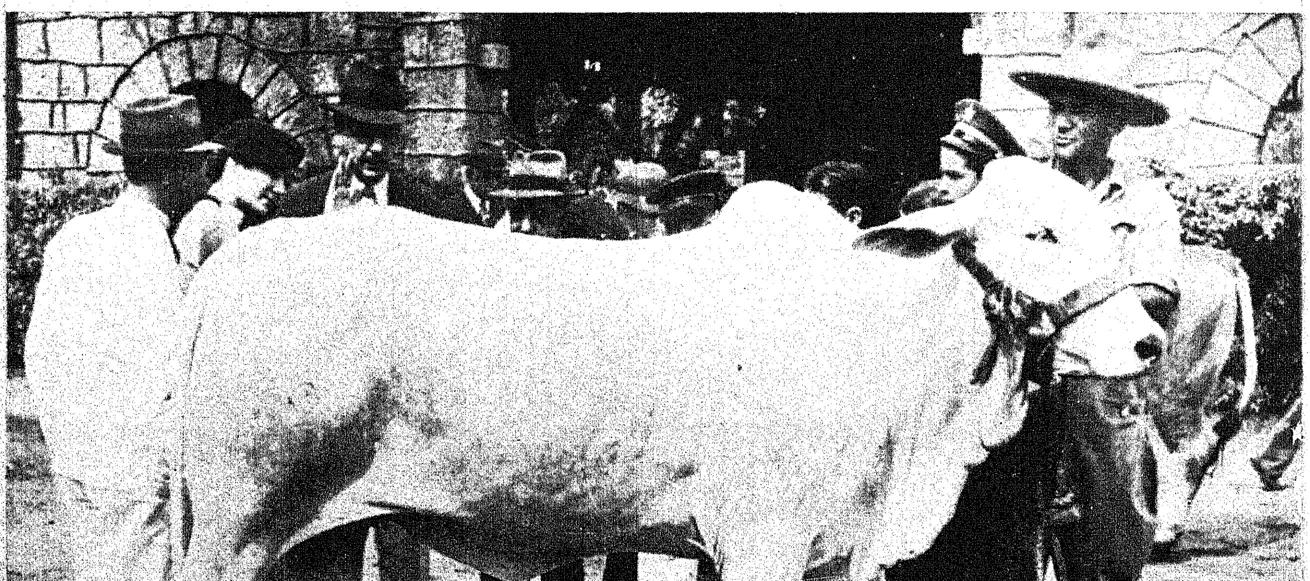
Fifth National Show of Animals, 1936

Soberano—(32 months old) bull. Breed—Nellore (Ongole); won the 1st prize in its class.

11 Bred and owned by Pedro Marques Nunes, Fazenda Indiana.

Alegria—($2\frac{1}{2}$ years old) calf. Breed—Nellore (Ongole); won the 1st prize in its class at the same Show.

Bred and owned by Pedro Marques Nunes, Fazenda Indiana.



INDIAN FARMING

ISSUED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II AUGUST 1941 No. 8

INDIAN CATTLE IN OTHER COUNTRIES

THE subject of cattle improvement in the tropical countries of the world has received a considerable amount of attention and various experiments have been conducted with a view to evolving a type of cattle that will thrive under the different climatic and other conditions which obtain in each country. Generally speaking, the well-known beef and milch breeds of Europe, which are efficient and economic producers in their own home, do not retain the high level of their efficiency under the rigours of a tropical climate, while the local cattle are usually too poor to be economic producers. For grading up these cattle a search has been made for a breed which combines the hardiness and the resistant qualities of the tropical animals with the producing capacities of the European, and evidence is accumulating to show that Indian zebu cattle are the best for such cross-breeding purposes, the actual proportion of Indian blood required for the maintenance of constitution and high level of production being dependent on the conditions in each area.

During the last thirty or forty years several batches of Indian cattle have been exported to other countries, and in various parts of the world, particularly South America, cross-breeding with the zebu is the established practice. There are breeders who keep herds of pure Indian cattle for the production and sale of pure-bred stud bulls. Unfortunately, full details are not available of the histories of these herds, but the photographs of Ongole cattle received recently from the Department of Agriculture, Brazil, show how well Indian cattle thrive in America. These animals are the progeny of Ongole cattle exported years ago from Madras, and it will be seen that they compare very well with the best Ongole animals now available in India. Encouraging reports have also been received regarding other breeds like the Gir, the Kankrej and the Sahiwal.

This increasing realization of the value of zebu blood in other tropical countries of the world is bound to result in an increasing demand for high-grade Indian cattle, and India has to decide whether or not to foster this export trade. Opinion in India on this point is not unanimous. One school of thought is for prohibiting export altogether, while another school is for encouraging export with safeguards. At present in India the number of high-class pedigree stock available is far short of requirements and there is an urgent necessity for increasing their production. Under present conditions the best way to encourage production is to enable the breeder to secure a good price. As the foreign purchaser is able to pay a much higher price than can be obtained in India, the development of the export market is bound to have a far-reaching effect on the production and rearing of pedigree stock in India, but if production does not keep pace with demand, or if sales are not controlled, there may be severe depletion in the numbers of high-class breeding stock and eventual extinction of a breed. This is illustrated in the case of the Ongole. Large batches of this breed, including females, were exported at one time and production was crippled owing to the land on which these cattle had been reared being immediately taken up for other purposes. This led to the virtual extinction of the breed, and although the export of Ongole cattle was

prohibited, the damage was done and prohibition has not helped substantially to revive the breed. Had there been an efficient organization working in the interests of the breed such wholesale export would not have taken place and steps would have been taken to increase production to cope with the large demand.

The solution of the problem seems to lie in the control, rather than the prohibition, of export coupled with an organization for the development of production of pedigree cattle. With the help of breed societies and an efficient Herd Book organization with its system of registration of all pure-bred animals, it should be possible to develop and control the export trade in the interests of both the breed and the breeder.

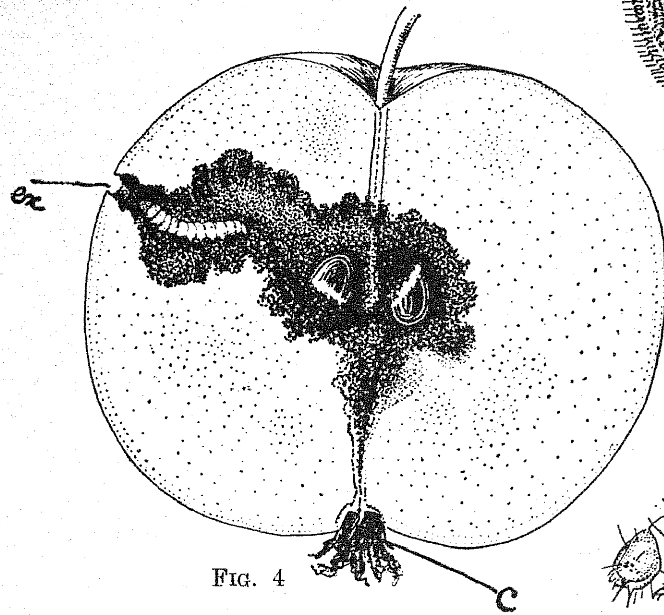


FIG. 4

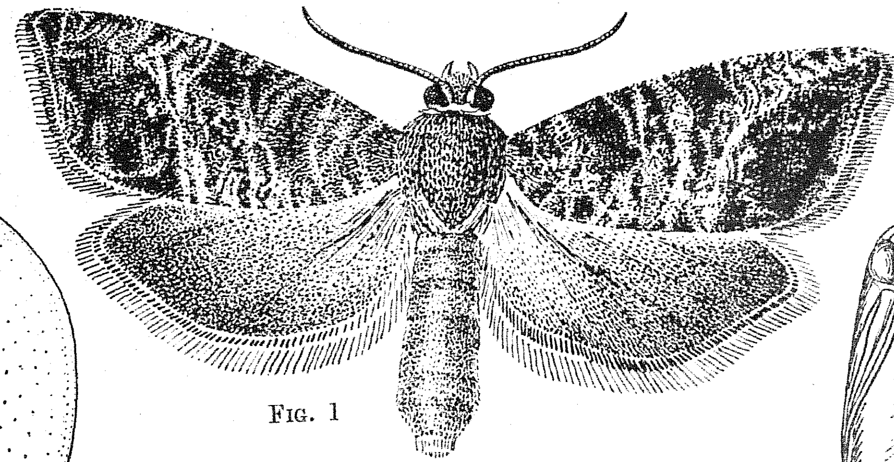


FIG. 1

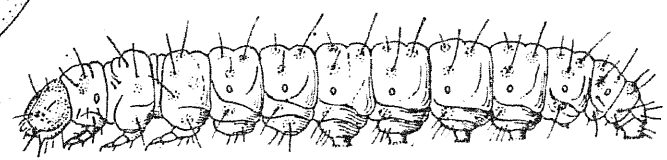


FIG. 2

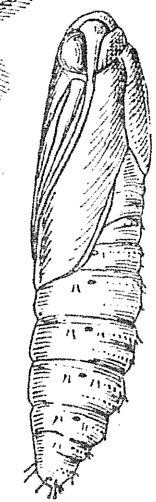


FIG. 3

FIG. 1. The Codling Moth × 6.
FIG. 2. The full-grown larva of the same × 6.
FIG. 3. The pupa of the same × 6.
FIG. 4. Section of an apple showing the damage done by the larva ; *c*, calyx cup through which the young larva enters the fruit ; *ex*, the hole through which the mature larva leaves the fruit after damaging it.

Illustrations from *Agriculture and Livestock in India*, Vol. V, Part 5

Original Articles

THE CODLING MOTH AND ITS CONTROL*

By S. C. Roy, M.Sc., B.Sc. (Agri.) (Lond.), Dip. Agri. (Wye.)

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THE Codling Moth, which is known to be a most serious pest of apples, pears, and other fruits in almost all the fruit-growing parts of the world, had not been definitely recorded from India up to 1935 when Dr H. S. Pruthi, Imperial Mycologist, reported it from the Quetta district of Baluchistan. The details will be found in *Agriculture and Livestock in India*, Vol. V, Part 5, pp. 522-3. Later in 1938, Dr Pruthi gave a further record of the occurrence of the Codling Moth from the North-West Frontier Province (*Agriculture and Livestock in India*, Vol. VIII, No. 1, pp. 42-3).

Distribution

In view of the notoriety of the Codling Moth, the Imperial Council of Agricultural Research sanctioned a small staff to assist Dr Pruthi in carrying out a survey of the fruit-growing regions of Baluchistan to ascertain the distribution and life-history of the Codling Moth and also to determine the exact nature of the damage done by another insect pest of apples in that province, namely *Spilonota ocellana*. The results of this study are given in a very interesting article by Dr Pruthi in *The Indian Journal of Agricultural Science*, Vol. VIII, Part 4, August 1938, pp. 499-519. Thus Dr Pruthi has established the occurrence of the Codling Moth in Baluchistan and has also recorded it from certain parts of the North-West Frontier Province. It is not definitely recorded from Kashmir and is not known from Kulu or the Kumaon hills or any other part of India.

Dr Pruthi has also shown that there is justification for the assumption that the Codling Moth occurs in Afghanistan and probably was and is being introduced into India from that country. The subsequent observations of Dr Taskhir Ahmad who visited Afghanistan as a member of a delegation to study the agricultural conditions of that country has confirmed this assumption. Dr Khan A. Rahman (Government Entomologist, Punjab) has further confirmed the assumption by an examination of the fruits brought from Kabul into Bannu and the Kurram Valley. He found that the percentage of Codling Moth infestation in apples imported from Kabul was from 40 to 64 per cent.

As crab apples produced in the Kurram Valley are sent to different markets in India, the next point examined by Dr Rahman was whether the fruit destined for export from the Kurram Valley was carrying Codling Moth caterpillars out of the valley. In these fruits Dr Rahman found a percentage of infestation varying between 12 to 93. He thus showed that the Codling Moth is exported with crab apples from the Kurram Valley and as the Kurram Valley apple ultimately finds its way into the markets of Kohat and Peshawar in the North-West Frontier Province, and to Lyallpur, Sargodha, Multan and Montgomery in the Punjab, he suggested strict quarantine measures to prevent the spread of this pest to other apple-growing tracts in India.

A destructive pest

According to Dr Pruthi: 'The adult moths appear in orchards in spring or early summer when the apple trees are in flower. The moth is about $\frac{1}{3}$ in. long and $\frac{2}{3}$ in. across the wings when fully expanded. The fore-wings are brownish grey, with a characteristic copper-coloured patch near their apices. The moth lays eggs usually one, occasionally two or three in number, on leaves, twigs and the outsides of the flowers. The eggs are small,

* With acknowledgements to *Farming in South Africa*, Vol. XIV, No. 163, October 1939, and *The Punjab Agricultural College Magazine*, Vol. VIII, No. 1. I am also grateful to Dr Pruthi and Dr Khan A. Rahman for having read the proofs before publication.

oval, very much flattened, resembling tiny, shining discs. The newly hatched larva is dirty-white in colour, with a brown or dark-brown head. It is very active.' Dr Rahman has given the following table to show the place of entry of the Codling Moth caterpillar in fruit. The caterpillar may enter the fruit at any place, and according to Dr Rahman's observations 44 per cent of the caterpillars enter the fruit through the calyx cup, 20 per cent through the stalk end, 14 per cent through the middle of the fruit and the remaining 21 per cent may enter it at any point. On penetration it feeds on the core and the pips of the fruit.

Place of entry of the Codling Moth caterpillar in fruits

Number examined	Number entering the fruit through			Number entering fruit at random
	Calyx cup or its vicinity	Stalk end or its vicinity	Middle part or its vicinity	
177	79	36	25	37

Dr Pruthi remarks: 'The "wormy" or infested fruits become shrivelled up and reduced in size and with even moderately strong wind are likely to drop off the tree. After feeding for three or four weeks within the fruit the larva becomes full-grown when it measures from $\frac{1}{2}$ to $\frac{3}{4}$ in. in length and has a pinkish colour on its dorsal side. It then starts eating its way out through the side of the fruit which may still be on the tree or may have dropped to the ground. The larva after leaving the fruit crawls under a suitable shelter, such as crevices of bark, folds of dead leaves, corners of broken packing cases and other rubbish where it spins a silken cocoon and passes the winter therein. At the approach of the following warm weather it pupates, and in due course emerges as adult moth and repeats the history outlined above. Sometimes the larva before entering the winter sleep may pass through another generation and thus there may be two generations in the year. The moths themselves do not eat anything except liquid substances like the juice of fermented apple. They fly about at dusk and spend the day hiding under dead leaves, bark, etc.'

As Dr Rahman has rightly pointed out, the Codling Moth is the most destructive and the most persistent pest of apple in America. It is said to be responsible for causing damage to the extent of three crores of rupees annually. No such figures are available in the North-West Frontier Province and in Baluchistan, but, keeping in view the fact that it destroys 90 per cent of the apple fruit in these two provinces annually, the damage caused by it must be colossal. In fact, people, particularly in the North-West Frontier Province, are abandoning the cultivation of apples altogether.

How it is controlled

With regard to control measures against the Codling Moth, Dr Pruthi states: 'From the foregoing brief account of the life-history of the Codling Moth it will be noticed that its larvae pass winter in the crevices of dead bark, under dry leaves, old packing cases and other rubbish lying about in orchards.' If all these shelters are removed and "wormy" apples destroyed whenever seen, the chances of the following crop getting infested will certainly be very much reduced. The soil round and below the trees should also be examined for the hibernating larvae which should be destroyed. Of course all the fruit-growers in a tract should take such measures simultaneously, otherwise the pest will easily travel from the clean orchards to the unclean ones. Sometimes these measures of cleanliness are not enough to keep the pest down and the larvae have to be killed directly by various sprays. In winter when there is no fear of injuring tender foliage and flowers, the trees can be cleaned with tar-distillate and other oily washes which, besides killing some of the hibernating larvae, reduce the number of cracks and crevices in which they can spin their cocoons. In summer a spray consisting of lead arsenate (1 lb. in 50 gallons of water) should be applied soon after the petals have just fallen off and before the calyx cups have closed so that some poison may get deposited in these cups, thus ensuring the death of the young larvae which, as described above,

generally enter the setting fruit by this way. It will be readily recognized that this is the most important and effective measure. This spray is repeated three or four times at an interval of 12 to 15 days during the summer to kill the larvae hatching out later or those of the second generation if there is any. Such larvae often enter the fruit from the side, especially if it is bruised or soft due to contact with neighbouring fruit. It may be added that lead arsenate is poisonous to man and domestic animals and must be used with care.

Orchard management

In view of the increasing danger of Codling Moth infestation in India, it may also be useful to examine briefly the measures advocated in an article by Stubbings and Nel entitled *Codling Moth in the Western Province (with special reference to coastal areas)* contained in the October 1940 issue of the journal '*Farming in South Africa*.' The following are extracts :

'Efficient orchard management is essential to the control of the Codling Moth. Plantings should be strictly limited to what the grower can handle with the supervision and labour available, to enable each control operation to be thorough and timely. Sufficient spray pumps should be available to permit all the pear and apple trees to be sprayed within four or five days at the critical periods, due allowance being made for possible stoppage in spraying on account of high winds, rain and mechanical breakdowns. Sufficient sprays should be applied not only to ensure a commercially clean crop but also to reduce the carry-over of over-wintering larvae from season to season. Thinning, picking out and destruction of infested fruit, removal and prompt disposal of wind-falls and pick-falls and carrying out of sanitation measures in the pack-house should form the essential practices.

Spray programmes

The spray programmes suggested are: lead arsenate and Blackleaf 155.

First-brood sprays.—First or calyx spray: This spray should be applied when the flowers start to shed their petals. A second calyx spray, particularly when blossoming, is irregular. The calyx spray for most pear and apple varieties will be due around October 20 or later, depending on the time of blossoming which is variable from year to year.

Spray mixture: lead arsenate, 4 lb., and spreader, 4 oz. per 100 gallons of water.

Second spray: Around October 28 (8 days after first spray). Spray mixture: 4 lb. lead arsenate per 100 gallons of water.

If it is necessary to include a fungicide at this stage, wettable sulphur should be used at the rate of 5 lb. per 100 gallons of water, instead of lime-sulphur.

Third spray: Around November 5 (8 days after second spray). Spray mixture: 3 lb. lead arsenate and 4 lb. Blackleaf 155 per 100 gallons of water.

Fourth spray: Around November 13 (8 days after third spray). Spray mixture 3 lb. lead arsenate and 4 lb. Blackleaf 155 per 100 gallons of water.

Fifth spray: Around November 23 (10 days after fourth spray). Spray mixture: 4 lb. lead arsenate per 100 gallons of water.

Second-brood sprays.—Sixth spray: Around December 18. Spray mixture: 4 lb. lead arsenate per 100 gallons of water.

Seventh spray: Around December 28 (10 days after sixth spray). Spray mixture: 3 lb. lead arsenate and 4 lb. Blackleaf 155 per 100 gallons of water.

Eighth spray: Around January 7 (10 days after seventh spray). Spray mixture: 3 lb. lead arsenate and 4 lb. Blackleaf 155 per 100 gallons of water.

Ninth spray: Around January 17 (10 days after eighth spray). Spray mixture: 8 lb. Blackleaf 155 per 100 gallons of water.

Third-brood spray.—Around February 13. Spray mixture: 8 lb. Blackleaf 155 per 100 gallons of water.

Non-washing programme

A programme that will control Codling Moth in heavily infested areas, and still allow the elimination of acid washing, has been drawn up at the request of several growers. The following programme, which cannot, however, be generally recommended owing to its high cost, is submitted for consideration :

Sprays 1 and 2 : As in the above programme.

Sprays 3 to 10: 8 lb. Blackleaf 155 per 100 gallons of water.

Sprays should be timed in accordance with the recommendations made in the preceding programme.

Application of sprays

Good spraying is essential to the success of a well-planned spray programme, and all parts of the tree should be thoroughly wetted with spray material during each application. To achieve this in practice, experienced sprayers and the correct spray equipment are necessary. As regards the latter, at least one power pump delivering 8 to 10 gallons per minute at a pressure of at least 250 lb. per square inch is needed for every 1,500 to 2,000 bearing trees, when convenient spray-mixing facilities and an adequate water supply are available. Under these conditions the grower will be in a position to spray all his trees thoroughly in four to five days, as is necessary during critical periods.

A fairly coarse driving spray should be used, since the mist type of spray-jet gives ineffective and uneven coverage, particularly in the case of large trees. For such trees a nozzle with a disc aperture of at least 4/64 inch is recommended. The indicated pressure should be about 250 to 300 lb. per square inch, and the discharge not more than 2½ to 3 gallons of spray material per spray rod per minute. Spray material should be used liberally and the ground under the trees should be thoroughly wet after spraying.

In the earliest sprays, when the calyx ends of the pears are pointing upwards, it is necessary to spray from above as well as from below. In the case of large trees, one of the labourers at each pump should be stationed on top of the spray tank or on an elevated spray platform, not only to fill all the calyces that cannot be reached from the ground, but also to facilitate the coverage of the tops throughout the entire season.'

It will be observed from what has been written above that the apple plants blossom during winter in Africa and, therefore, the calyx spray starts about the third week of October when the flowers begin to shed their petals. In India the plants generally blossom and fruit during April to August and the damage of the Codling Moth is at its height during this period. The first spraying, however, is given when the flowers start to shed their petals and all the subsequent sprays are at intervals of a week or more after calyx spray. Under Indian conditions, therefore, the African programme given above should be suitably modified so that the first spraying starts about the time the petals begin to shed followed by the subsequent sprays at intervals of seven or more days.

It is also to be remembered that when apples have received two or more sprays of lead arsenate, the fruits destined for human consumption should be washed in a weak solution of nitric acid to wash off the poisonous residue.

The following are further extracts from the South African article :

' Finally, much depends on the organization and supervision of the grower or his deputy. Thorough spraying will hardly ever be done by local labour without close supervision.

Supplementary control measures

Even when spraying is satisfactory, an occasional Codling Moth larva may enter the fruit and complete its life-cycle. Then again, rain and high winds or a succession of accidents to the spray pumps may occasionally unavoidably delay spraying at the critical period. Therefore, supplementary measures to spraying should be carried out. These supplementary measures are :

Scraping of trees.—A very large proportion of the over-wintering larvae which carry the pest over from one season to another are found on the trees or in the soil around the base of the trunk. Favourite cocooning quarters are under rough bark, in cracked branches, and in old pruning or grafting wounds.

Many of these larvae can be destroyed by scraping off loose and rough bark during the winter, by removing cracked branches, and by cutting out rotten wood and filling up holes with tree-seal. Thorough scraping-off of the loose bark is a very desirable precursor to winter spraying and is essential to the success of banding.

Banding of the trunks.—If the trees are thoroughly scraped and the cocooning quarters removed from the trees in winter, many

of the worms leaving the fruit during summer will enter and cocoon in bands placed round the trunks of the trees. Either double hessian bands or chemically-treated codling bands may be used for this purpose, and should be placed in position round the trunks during early November, i.e. before the earliest first-brood larvae commence to leave the fruit. Hessian bands should be examined every 10 days throughout the season up to the end of February, and all larvae should be killed; the bands are removed from the trees during winter, checked over for larvae and stored for use the following season. Chemically treated bands automatically kill the larvae and need no attention during the season. They should be removed and burnt during winter to destroy any larvae that have entered late in February and have not been killed owing to the deterioration of the chemical coating.

Picking out and thinning of fruit.—The thinning out of large bunches of fruit is not only instrumental in improving the size of the fruits, but aids the penetration of sprays between the individual fruits of the cluster. If this operation is carried out during the latter half of November, and early in December in the case of late-blossoming varieties, most of the infested fruits can be removed and destroyed before the larvae have left them. If labour is available, all infested fruits should again be removed from the trees around the middle of January and should promptly be destroyed.

Disposal of wind-fall and pick-fall fruit.—All fruit falling from the trees from January onwards should be picked up and destroyed at least three times weekly. This operation is essential where the fruit is heavily infested at times when most of the larvae are nearly full-grown. When such fruit is buried it should be covered up immediately with a compact layer of soil at least 18 inches in depth.

Packhouses, fruit-stores and lug-boxes.—Thousands of infested fruits pass through the packhouse at picking time. Larvae often leave these fruits to spin cocoons in the packhouses or fruit-ripening rooms and emerge as moths during the same season or the following spring. Moths emerge later in spring from packhouses and store-rooms than from trees in the orchard, and this tends to lengthen the emergence periods of the first brood, making control more difficult.

Packhouses and fruit-stores should have smooth floors, preferably of concrete or bitumen, free from cracks or crevices in which the larvae might shelter. All walls should be rounded off at floor level, which can easily be done when concrete is used, and smoothly plastered up to a height of about three feet. A trap-plank, such as that described by Dr Pettey in Bulletin No. 9 issued by the Department of Agriculture in 1926, should be brought round the wall at a height of about three feet from the floor to enable larvae escaping from the fruit to be trapped in hessian or chemically-treated bands. Alternatively, all windows should be moth-proofed with fine wire gauze, and swing-doors of the same material should be provided, in order that moths which emerge in the packhouse might be prevented from escaping into the orchards.

Lug-boxes used during the previous season should be kept in a moth-proofed store-room until the middle of December, when larvae which have accumulated in them at the end of the previous season will have emerged as moths. During the season, particularly around the beginning of February, all lug-boxes should be treated to destroy any larvae they may contain. According to American experience, all larvae can be killed by submerging the boxes in very hot water. Where the temperature is 190°F., an immersion of at least one minute is desirable; where the temperature is 175°F. a two-minute immersion is required.'

Danger to apple cultivation

The main point is that the pest must be controlled even if the procedure of doing so is expensive and troublesome; otherwise apple cultivation may disappear.

Mr M. R. Fotidar, Director of Agriculture, Kashmir, has, in the May 1941 issue of INDIAN FARMING, described organized spraying against the San José Scale: something similar is needed for the Codling Moth. In addition something has to be done to check the distribution of infected fruits.

MARKETING OF EGGS AND EGG PRODUCTS

By A. J. MACDONALD, B.Sc., B.Sc. (AGRI.), N.D.A.

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THE average consumption of eggs per person in India works out at eight per annum, whereas in many other countries the consumption is 30 to 40 times this number. This low consumption of eggs in India is, in part due to the fact that most of the population are vegetarian; nevertheless even among non-vegetarians the average consumption is comparatively low. The expansion of consumption is further retarded by the poverty of the great mass of the people, who prefer to buy cheap products such as cereals rather than a more expensive but more nutritive food, such as eggs. Another reason for low consumption is the fact that in the ordinary market there is no guarantee of quality.

Quality essential

The problem of efficient marketing of such a highly perishable product as eggs is of primary importance to producers, for ready sales and good prices can only be obtained by supplying consumers with good quality eggs. In the first instance, the producer must strive to produce eggs of first-class quality. In the second instance, he must strive to retain the original quality of the new-laid egg. Thereafter, from the producer to the consumer, the various people concerned in marketing should make every effort to prevent undue deterioration in quality.

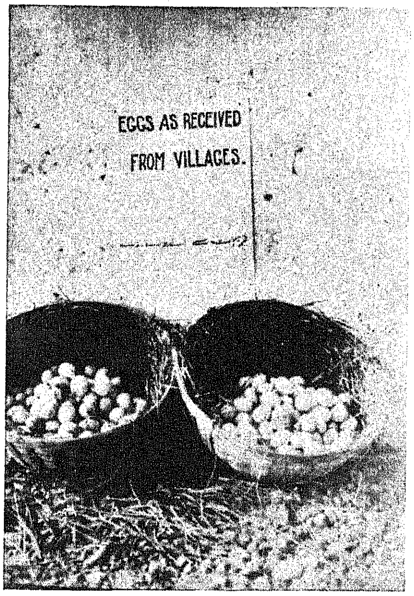
Quality in eggs with reference to food and market values is measured by (1) the external appearance, (2) by candling and (3) by the physical appearance, odour and flavour of the contents. For ordinary commercial purposes it is possible to judge quality by candling but for scientific work more exact measurements of quality are desirable, for the commercial methods of judging quality are open to the objection that they rely almost entirely upon the judgement of the individual candler.

Grading

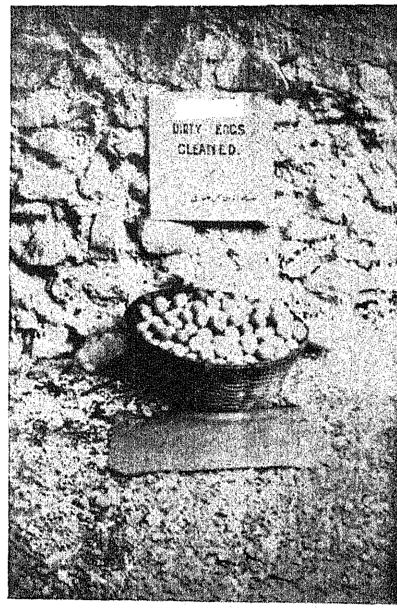
The external appearance of eggs, as judged by size, shape, shell, colour and cleanliness is very important in marketing. Weight for weight, large eggs of good quality invariably fetch higher prices than good quality small eggs. In high-class markets eggs are now graded according to size or rather weight, for uniformly sized eggs fetch better prices than eggs of mixed sizes. Though the shape of an egg is not of primary importance, good shaped eggs look more attractive and are less liable to damage in transit than eggs of abnormal-shape. It is necessary for the producer to try to satisfy the fancies of his customers; though there is no relationship between shell colour and quality of the contents, many individuals prefer brown eggs for example. As shell colour is mainly a breed characteristic, producers can, if necessary, keep those breeds which lay eggs which are most pleasing to the public. Eggs which are cracked or thin-shelled should be used by the producer or sold locally, for defective shelled eggs do not keep or travel well. Dirty eggs spoil the appearance of a consignment and materially lower its market value. As dirty eggs can never be made to look as attractive as eggs that have never been soiled, producers should endeavour to lower the incidence of dirty eggs amongst their stocks. Birds should be provided with ample nesting space in cool dark places and the nesting material should be kept clean. During wet weather stagnant pools of water should be drained in order to prevent the birds soiling the eggs with their feet.

Judging quality

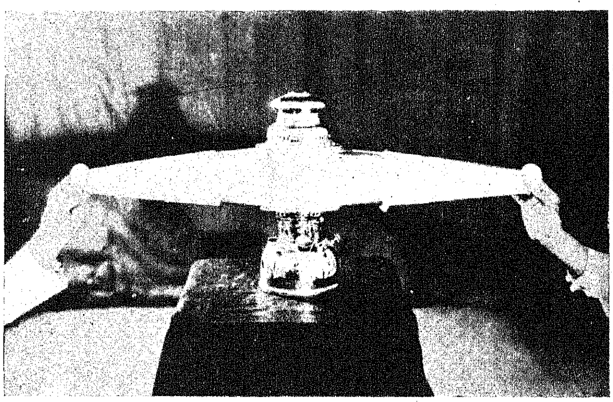
Though certain individuals claim that it is possible to estimate the quality of eggs by touch, little or no reliance can be placed on such a method of judgement. One method of roughly judging quality is to place the eggs



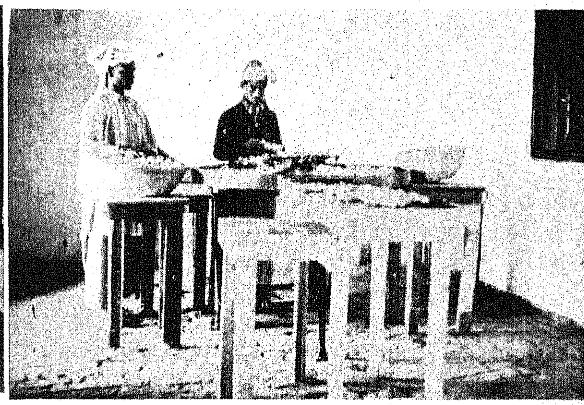
First stage. The photograph on the left shows dirty, cracked and stale eggs as received from villages. The other on the right shows village eggs after sorting and cleaning.



Second stage: The eggs are candled.

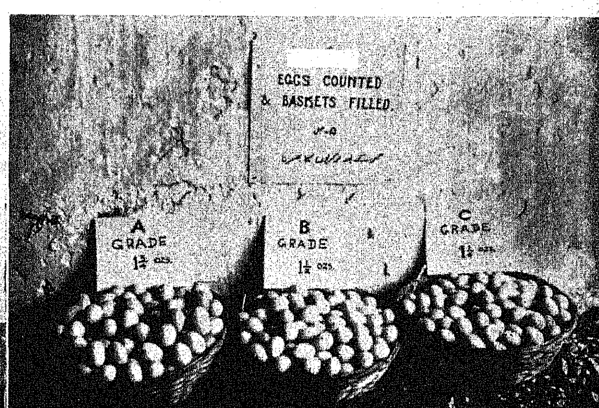


Third stage: The eggs are graded.



Fourth stage: The eggs are stamped with AGMARK. *Note the grading machine on the left.*

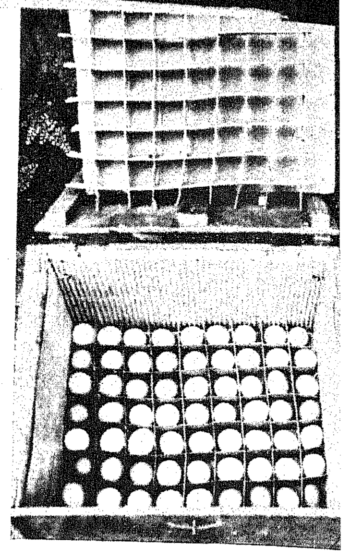
Fifth stage: The eggs are packed according to the grades.



Photographs from the *Report on the Marketing of Eggs in India and Burma* (1938)

PLATE 113]

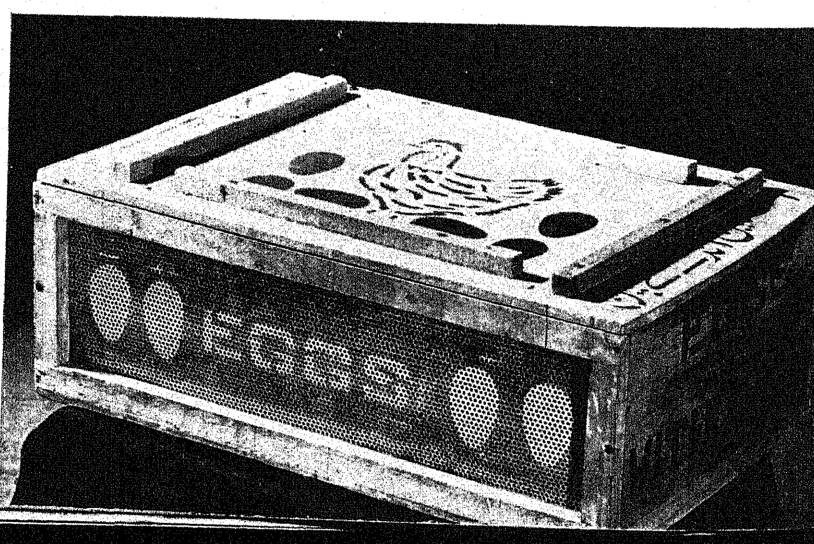
Egg baskets, being piled with safety, at Kottaakara (Travancore State)



Box used at some farms

Left : An improved type of container

Right : A revised type of container



Photographs from the *Report on the Marketing of Eggs in India and Burma* (1938)

in cold water ; very stale eggs will float whereas good eggs and medium quality eggs will remain at the bottom of the container. A common practice amongst egg merchants is to hold the egg up to the sun and with a little practice very stale or incubated eggs can be detected with a fair amount of accuracy. However, sun-candling, as this is called, is not sufficiently accurate even for ordinary commercial candling. A much better method of candling is to place the egg between a bright light and the eye of the observer. The candling lamp is so designed that the light is reflected through a small aperture and, when the egg is placed in front of this, it is possible to study the internal contents. Candling is usually carried out in a dark room and with the broad end of the egg upwards the egg is turned round rapidly in order to rotate the white and the yolk.

In a perfectly fresh normal egg, the air cell at the broad end is very small and the yolk is situated centrally and is only dimly visible. In eggs that are stale the air cell is large and the yolk is usually 'sunken', 'sided' and clearly visible. The rate of deterioration that occurs after laying depends on the conditions of storage. Under ideal conditions eggs can be made to retain their good quality over long periods. The rate of increase in the size of the air cell depends on temperature and humidity ; that is, the hotter and drier the storage conditions, the greater the evaporation of water and the larger the air cell. In the hot months prior to the monsoon, the amount of deterioration in 24 hours is greater than that suffered in seven days in the cold weather.

Egg-faults

Unfortunately all eggs are not of first quality even when new-laid and candling is necessary to remove defective ones which lower the quality of the batch from the commercial standpoint, even though the contents of these eggs may be quite edible. One of the commonest of these faults is 'meat spots' which are caused by small bits of tissue from the ovary or oviduct becoming enclosed within the shell. Though meat-spot eggs are edible, their appearance is slightly objectionable and they should be excluded from ordinary trade channels. Blood spots are due to the rupture of a small blood vessel during egg formation and as they are very unsightly in appearance, such eggs should be removed when candling. A common and most objectionable fault which is very prevalent during hot weather is that of embryo development. Embryo development in the fertile egg can proceed slowly at any temperature above 70°F. but the rate of development is not unduly rapid until the temperature rises to 90°F. or over. One way of preventing embryo development is to remove the males from the laying pens since their presence there is not necessary except during the breeding season. (Incidentally, the common belief that the presence of a male is necessary or beneficial for good egg production is entirely erroneous.) Other minor egg-shell faults, such as hair-cracks, which are not evident to the naked eye, are easily picked out under the candling lamp. During the hot weather, rots and moulds are not uncommon, especially if the eggs are stored for any length of time under dirty and damp conditions.

So far only a small percentage of the eggs produced in this country are candled and graded prior to marketing but, thanks to the efforts of the various marketing staffs, considerable progress has been made during the last two years. However, progress is bound to be somewhat slow in the initial stages, for producer, middleman and consumer have all to be educated in regard to the desirability of marketing a product of standard quality. The standard of quality set at the grading stations should be kept even higher than that called for in more temperate countries for a certain amount of time must elapse before the eggs reach the consumer's table and in a hot climate deterioration is rapid.

Though the costs of production in India are low, little effort has yet been made to capture important egg markets in other countries. Owing to the small size of the Indian egg it may be difficult to receive satisfactory prices in overseas egg-in-shell markets but, in large importing centres such as London, it is possible that satisfactory prices, even for small eggs, could be obtained from October to January, though during other months, when large eggs are relatively inexpensive, there is

little or no trade in small eggs. A sound business in eggs-in-shell can only be built up through large-scale exports of good-quality products and to ensure quality it is necessary to have strict supervision and inspection at all stages of transit between the packing station and the port of importation.

Storage

One of the major problems in marketing eggs in the hot weather is that of rapid deterioration that sets in as soon as the eggs are laid. As already mentioned, the producer should not mate his birds at this period and the nests should be placed in shady places. The eggs should be gathered several times a day and stored in the coolest possible place until despatched to the market. If stored in an ordinary room, eggs should be placed in a well-ventilated receptacle, such as a wire basket, so that they will cool down as quickly as possible. The room should have a relatively high humidity which may be obtained by damping the floor and hanging wet hessian cloth, etc. over open doors and windows. The dry air from outside, when it comes in contact with the wet surface, will take up a considerable amount of moisture and in the process the air in the room can often be lowered 10 to 15°F. Underground chambers can also be used very successfully for storing eggs. The eggs should be marketed at regular intervals and in very hot weather the producer should, if at all possible, sell his eggs every two or three days. Exposure of eggs to the direct rays of the sun during transit to the market should be avoided by covering them and arrangements should be made to provide quick means of transport. In the market every effort should be made to market eggs as expeditiously as possible and they should again be stored in a cool place until delivered to the consumer.

On most farms a small number of dirty eggs are inevitable and, since they should not be marketed in a dirty condition, they present a problem to the farmer who knows that washing eggs with water removes the bloom, spoils their appearance and materially lowers their keeping quality. Dirty eggs can, however, be cleaned fairly safely by wiping them with a clean, damp cloth or by washing in a 0·5 per cent solution of sodium hydroxide (caustic soda).

Eggs-in-shell can be kept for a number of months if stored at 30°F. with a relative humidity of 85 per cent ; if eggs-in-shell are to be exported, arrangements for suitable storage must be made at all large collecting centres prior to shipping them. As regards methods of storage for internal consumption, there seems little value in trying to store eggs over long periods as their price throughout the year is fairly constant. The main problem in marketing eggs for home consumption is to ensure their retaining quality for a limited period. The period that elapses between production and consumption is unfortunately far too long on account of the irregular collection in the villages, the numerous hands that the eggs pass through before reaching the consumer, the slow transport and the often long distances between the areas of production and consumption. In the cold weather eggs normally retain their good quality for from two to three weeks, but in the hot weather eggs will show marked deterioration in less than a week. So far no practical method of extending the edible life of the egg for another week or two during the hot weather has been found, but it is hoped that researches now in progress will soon offer a practical solution to the problem.

Frozen eggs

China has built up a very large trade in frozen eggs. With this method of marketing, the eggs are candled and then broken under controlled conditions and carefully examined for defects. The good eggs are subsequently frozen at a low temperature and kept in sealed containers in a frozen condition until distributed to the consumer. The combined white and yolk is sometimes frozen together after churning up the contents but in recent years the practice of separating the yolks and whites and packing them in separate containers has become more common. So far no attempt has been made in India to build up a frozen egg industry but it appears that such an industry could be built up fairly successfully near the large ports. As small-scale production is uneconomic on account of capital costs,

a successful business could only be built up in an area where there is an abundant supply of eggs. As the quality of the frozen eggs is mainly determined by the freshness of the eggs used, steps would have to be taken to ensure quick handling right from the producer to the factory.

Drying of eggs

The drying of eggs is another method of preserving egg quality which has been considerably developed in a few countries during recent years. Though eggs may be dried crudely in a number of ways, good class products can only be obtained by rather expensive machinery run under well-controlled conditions. The three main commercial methods of drying are the belt, the spray and the pan. In the belt process the whole egg mixture is placed on a moving aluminium belt and heated to 160°F. in order to remove the moisture. After a period of drying the flaked material is scraped off. The resultant material is very popular in the bakery trade but unfortunately the product cannot be kept for any length of time unless stored at a temperature between 40° and 50°F.

In the spray method, liquid white, liquid yolk or liquid whole egg, after suitable processing, is sprayed under very high pressure through nozzles into a chamber kept at 150°F. The moisture is removed almost immediately and the residue falls to the floor of the chamber as a very fine powder. The dried egg powder can be stored for a year or more without the aid of refrigeration.

In pan-drying the fermented liquid white (albumen) is placed in metal pans or trays which have been given a coating of vaseline. The pans are then placed in racks in a heated cabinet and left there for 48 to 72 hours until the contents are thoroughly dry. The dried material is then removed from the pans, cooled, broken into flakes and packed in sealed containers.

The prospects for building up a good Indian trade in dried egg products are at present quite good, for the exports from China, which used to be much the largest exporter, have fallen off very considerably during the last two years. The various processes of drying eggs are, however, highly technical and, as most of the technical information in regard to processing is in the hands of large business concerns, it would be dangerous to set up egg-drying factories without prior investigation into the methods of production.

UTILIZATION OF INFERIOR GRADES OF CITRUS FRUIT

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UNDER the present admittedly undeveloped stage of fruit growing in India, it would perhaps seem strange to many that thought should be directed to diversion of surplus fruits into the by-products industries. A little consideration would, however, convince anyone that now is the opportunity to sound a timely warning against indiscriminate marketing of good, bad and indifferent fruit so that the as yet infant fruit-growing industry may develop along healthy lines.

Dangers ahead

Without adequate provision for economically utilizing the surplus and especially second- and third-class fruits in the manufacture of by-products, the fresh fruit market is bound to suffer. On the one hand prices may be forced below the economic limit for the grower and on the other many growers, especially the small ones, may be tempted to sell the inferior grade fruit along with those of good quality with obvious irreparable harm in the long run to all parties concerned. It is quite true that such measures as judicious selection of varieties for planting, careful nursing of the trees and prophylactic measures against fungus and insect attack can and are reducing the percentage of inferior fruit. The Agricultural Departments of various provinces are doing laudable work to encourage scientific fruit culture. Nevertheless, even the most efficiently managed orchards have to count quite a large percentage of their annual fruit crop as ' cull ' grade or unsaleable fruits.

The present article is concerned with the economical utilization of ' cull ' grade as well as second-class fruits of the citrus family only, and although this would interest mainly citrus fruit growers, nevertheless it might indicate to proprietors of orchards specializing in other fruits the lines along which their present revenues may be improved and future prosperity secured.

Problem of damaged fruit

The growing of citrus fruits is becoming more and more popular in the Punjab. In spite of every precaution taken by the growers, a part of the annual crop of oranges, lemons, limes, grapefruit, mandarines, citrons, etc. always turns out to be of inferior quality. Such factors as injury by frost, sunburn, windfalls, occasional heavy rain, etc., against which there is no protection, contribute to this state of affairs. The problem is not so great for the small growers but is important for the large fruit growers, and one or two of the very large fruit farms where this problem is very acute indeed are spending large sums of money in practical investigations on by-products. Quite apart from finding more remunerative outlets, there is the question, in the case of windfalls, of keeping the orchards sanitary, as injured fruits lying about the trees are fertile breeding places for disease-producing microbes and insects. Further, in some districts of the Punjab at any rate, there is actually the question of a permanent surplus of such fruit like *galgal* and *khatta* for which some outlet has to be found.

Large-scale manufacture essential

For successful production of really high-grade products and their profitable marketing, however, with the possible exception of a few of the products mentioned below, it is necessary that manufacture be carried out in a few large centralized factories fully equipped with efficient machinery and laboratories and staffed by qualified chemists and technologists. Some of the products are important industrial chemicals of which the trade demands a high state of purity and standard-

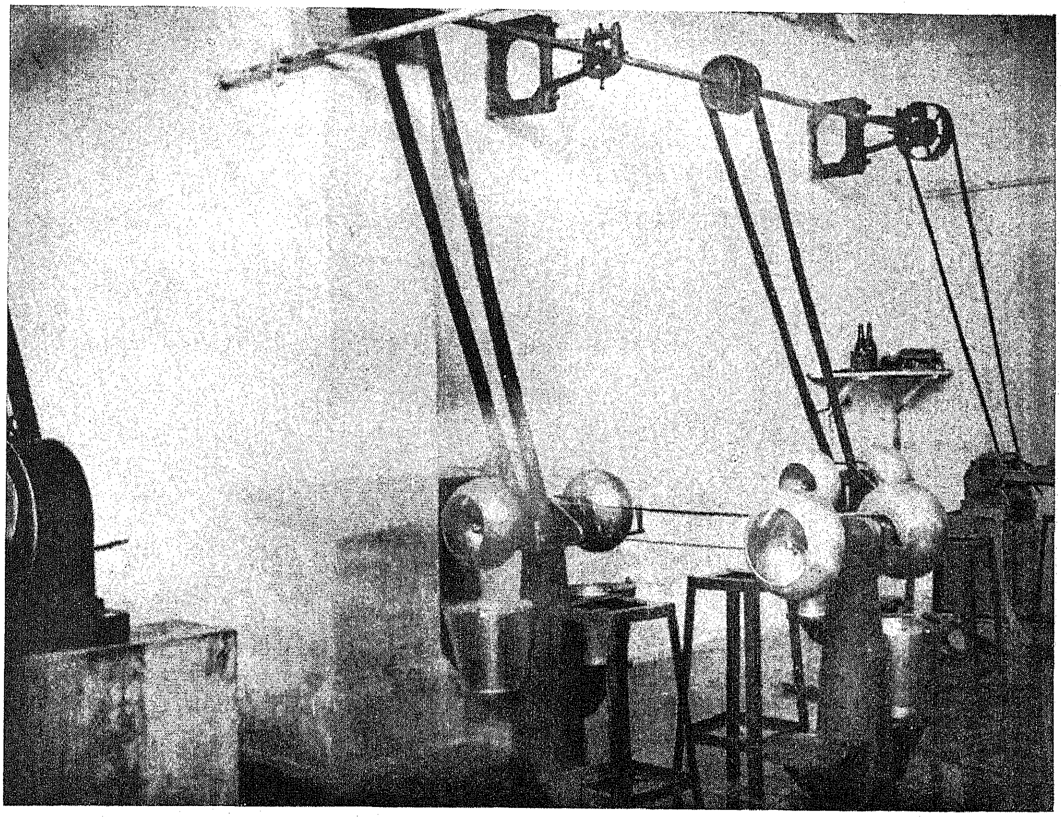

FIG. 1. Extraction of fruit juice requires utmost care and cleanliness. In the fruit extractors shown here the juice is automatically extracted from halved citrus fruit. The machines are made of hygienic stainless steel.

FIG. 2. Inside a large fruit juice bottling factory. In the background is seen a bottle cleaning and sterilizing unit which renders bottles clean and perfectly hygienic. In the foreground is an automatic bottle filler which can fill up to 10,000 bottles per 24 hours.

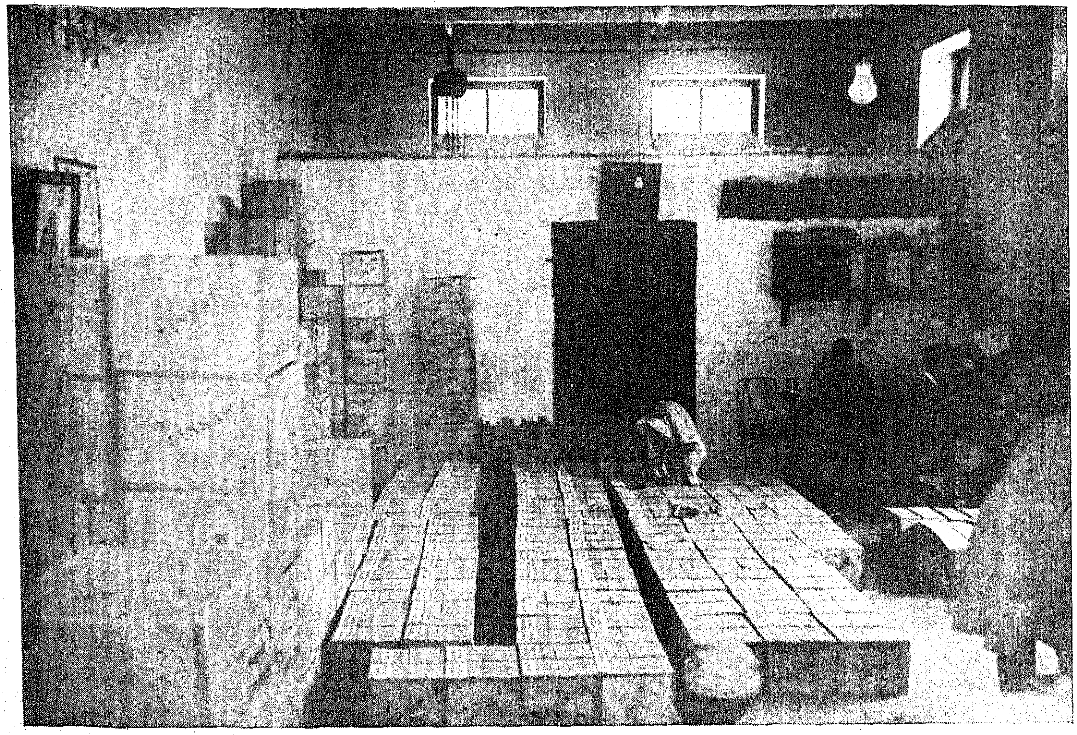

FIG. 3. Inside the packing shed. Hundreds of cases of different fruit products are despatched daily to all parts of India, Burma, Ceylon, the Near East and Far East

FIG. 4. The magnitude of a large orange farm may be judged from this photograph which shows only one of the hundreds of acres under cultivation for oranges alone at the Indian Mildura Fruit Farms. Such large units are bound to have a percentage of 'cull' fruits whose economic disposal is a problem.

ization not possible in old-fashioned small factories with little chemical and microbiological control. Competition from powerful foreign business interests can never be faced without methods of mass production in which rigid control and attention to detail are of paramount importance.

This leads to the question of the size of the factories. In view of the heavy overhead expenses, it is the definite opinion of the writer that the margin of profit will be attractive only if operations are carried out on a fairly big scale. The greater the turnover the greater will be the profit per ton of fruit handled. It is not possible to present here actual data on which this conclusion is based, but the case of the 'Jaf-Ora' Cooperative Society of Rehoboth, Palestine, may be cited because the Palestinian citrus fruit industry resembles in certain ways the conditions which might prevail in a few years in the citrus fruit industry of this country. 'Jaf-Ora' is a cooperative society started in 1932 to take off for the manufacture of by-products the surplus citrus fruits of a group of participating fruit growers with an annual output of about 1,000 tons of fruit. After overcoming all the technical difficulties, it was discovered that profits would not be substantial enough unless at least 3,000 tons of surplus citrus fruits were dealt with every year. This expansion was then carried out and the concern is now yielding very handsome profits after paying the price of the fruit.

Indian prospects

With cheaper labour an indigenous concern may run profitably with a somewhat lower capacity, but a certain minimum will even then have to be fixed. In order to bring such a state of affairs into being there seem to be two courses open. Either the largest growers should instal plants of sufficient capacity to handle not only their own surplus crop but also the inferior and surplus citrus fruits of the surrounding districts. Or a number of orchardists big and small may cooperate and instal a joint plant, each member receiving a share of the profits commensurate with the capital or fruit subscribed by him. The Government could cooperate in safeguarding the interests of the smaller members by fixing a minimum price for inferior fruit of a certain class.

Researches on the subject of utilization of surplus citrus fruits financed by the Indian Mildura Fruit Farms, Renala Khurd, have for the past few years been in progress in the University Chemical Laboratories, Lahore, under Prof. J. N. Ray and the present author and a large amount of experimental work has been completed. Methods of manufacture of a large number of high-class products and by-products at low expense have been worked out in detail. Commercial manufacture of many of these has already been successfully undertaken and pilot plants for others have been erected which promise to develop very soon into independent profit-bearing industrial units. Space does not permit a detailed description of the various processes involved. Only brief references to the different products for which surplus citrus fruits may be utilized will therefore be made.

Essential oils

The essential oil in citrus fruits resides almost entirely in tiny oil sacs embedded in the outer portion of the skin. The quality and yield of oil with any citrus fruit varies tremendously with the varieties, maturity, state of desiccation, method of extraction, etc. In the orchards of the Indian Mildura Fruit Farms, experiments are in progress to study the influence of watering of the trees in different ways, sunshine, maturity, etc. on the yield of essential oil per ton of fruit and its chemical composition. Actually only lemon and orange oils find a ready market in this country, but the export demand for grapefruit oil can be stimulated. The quality of lemon oil is usually assessed on the basis of its citral content, the minimum amount laid down by the British Pharmacopoeia being 4 per cent. Citral is the substance to which most of the strength of odour of the oil is due. The remainder of the oil consist of substances called terpenes. The citral obtained by fractional distillation of lemon-grass (*Andropogon* sp.) has, however, nothing to compare in the fineness of odour with

that obtained from the lemon fruit. The writer has examined a large number of lemon oils both imported and indigenous and has found some of the latter to be deficient in citral. It is therefore recommended that such oils should be subjected to vacuum distillation to remove a part of the limonene which is a terpene and forms the bulk of lemon oil but does not contribute very much to its odour. In the case of orange oil the odour is a blend of a large number of compounds, although here also the percentage of total aldehydes (a group of sweet-smelling organic compounds) gives valuable information about the quality of the oil. As with lemon oil, the strength of odour of orange oil and consequently its market value may be increased by removing a portion of the terpenes. Such concentrated terpeneless citrus oils are regular articles of commerce. In a hot climate the citrus essential oils have to be carefully protected against deterioration of their odour through (presumably) oxidation by air and the formation of substances of resinous nature.

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Pectin

Pectin is a complex mixture consisting mainly of a carbohydrate which is a derivative of an acid called galacturonic acid and some sugars. It is distributed throughout the body of the citrus fruit but is concentrated mainly in the inner white portion of the peel. Apart from the citrus family, it occurs abundantly in other fruits also, especially in apples and beetroot, but apples and citrus fruits are the only sources thus far exploited, although beetroot is now also being used. The commercial value of pectin lies in its mucilagenous and jelly-forming properties and from the latter standpoint citrus pectin is on the whole the best. Pectin is marketed either in the powdered form or as a clear syrup. At present the main use of pectin is in the jam, jelly and preserve industries as well as in home-scale fruit preservation. For this purpose the trade demands pectins with high jelly-grade, i.e. the parts by weight of sugar which one part of pectin will set into a standard jelly at the optimum acidity. Other qualities demanded are absence of colour and flavour, a well-defined rate of setting and in the case of powdered pectin, an ease of wettability. As regards jelly-grade, experiments have failed to corroborate entirely the often expressed view that the jellyfying property of pectin is proportional to the percentage of methoxyl groups present in its molecule.✗ But there is no doubt that uncontrolled methods of extraction which might lead to partial removal of these methoxyl groups have also resulted in a decrease in jelly-grade ; hence the emphasis on analytical control in its manufacture. Different manufacturers have their own usually secret or patented methods of preparation of this article. But the basic process involved is extraction of the crushed fruit with hot water and concentration or precipitation of pectin from the extract. Precipitation is accomplished by different methods many of which are covered by patents. The purified extracts can also be vacuum-spray-dried into a powder. Apart from the uses mentioned above, pectin also finds employment in confections, in emulsions of various kinds, and in mucilagenous preparations. Crude pectin is employed in tanneries, and, given cheap processes of manufacture, its use could well be extended in all directions where mucilages are employed. All kinds of 'cull' grade citrus fruits can be employed for its manufacture, although the yield and jelly-grade varies with the state of maturity.

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Citric acid and its salts

The manufacture of citric acid can be brought on a paying basis only with the very acid citrus fruits like *galgal*, lemon and *khatta*. During the present wartime conditions, the market price of citric acid has advanced 50 to 60 per cent and this leaves a slight margin for profitable production from indigenous sources. With sufficiently large outturn, the manufacture of citric acid may be profitable even under normal conditions, but watch should be kept on the fermentation citric acid industry in which this acid is produced from a cheap source of crude sugars through the agency of molds. The process of manufacture starting from citrus juices comprises either direct crystallization or precipitation as an alkaline earth salt and decom-

position of the latter with strong sulphuric acid. Citric acid finds extensive use in the manufacture of still and carbonated drinks, in confectionery and some preserves. Both citric acid and some of its salts are important pharmaceutical compounds; the acid, moreover, is employed in certain other industries. Commercial citric acid is usually almost white in colour and varies in purity according to the purpose for which it is to be used. For all edible purposes, whether in drinks and confections or as medicine, absence of lead is obviously essential. If proper precautions are taken during manufacture, it is possible to produce almost colourless crystals without repeated recrystallizations which reduce the yield.

Juices, preserves, essences, beverages

Research on behalf of the Indian Mildura Fruit Farms has been done on the successful production from citrus fruits of high-grade pure citrus juices, squashes, concentrates, carbonated drinks, soda water and cocktail bases, jellies, marmalades, canned preserves, candied peel, essences for cooking and for mineral waters and liqueurs and finally alcoholic beverages including wines and liqueurs of various kinds. Based on these investigations, manufacture of many of these products is already being carried out on a large scale and others are about to be commercially exploited. But apart from lack of space, a description of these products is out of place in an article of this nature, because extremely important though these products are from the commercial point of view, their manufacture does not readily adapt itself to the utilization of inferior citrus fruits, and apart from the cost of fruit the production of these articles involves many times more expense in sugar and other raw materials and in packaging. These products, therefore, are not potential outlets for the vast quantities of third-class citrus fruits that may be expected to accumulate when fruit-growing has developed into an important branch of agriculture in this country.

Cattle feed

A portion of the 'cull' grade citrus crop may be too low in citric acid and essential oil or pectin to make their extraction profitable; and if it is of a very inferior quality, it may well be converted into cattle feed. This would take off, for example, the windfall fruits and those partially injured by birds or molds. Besides, even after citric acid or essential oil has been extracted from the 'cull' grade fruit, the question of economical disposal of the residue still remains. Citrus waste is a highly digestible, essentially carbohydrate feed, being low in protein, fibre and fat and high in nitrogen free extract as shown by the following table of analysis for dried waste orange and lemon pulp:

Dried fruit by-product	Dry matter	Crude protein	Crude fibre	Nitrogen free ext.	Crude fat	Ash
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Composition of the product						
Orange pulp .	87·5	7·7	7·8	67·8	1·7	3·35
Lemon ,, .	92·9	6·4	15·0	65·2	1·2	5·0
Coefficients of digestibility						
Orange pulp .	89·3	78·5	83·7	95·4	48·9	—
Lemon ,, .	81·4	46·2	60·3	92·0	27·4	—

Orange and lemon pulps therefore contain large amounts of highly digestible nitrogen free extract which comprises mainly the carbohydrates. The dried pulp is quite palatable to the cattle and, in the case of cows and buffaloes, imparts no extraneous flavour to the milk even when considerable amounts are fed to them daily. General effects according to Neal *et al** are favourable as indicated by a thrifty appearance, gloss of the coat of hair and improvement in thickness of flesh. The present author has sun-dried waste orange and lemon pulp along with waste residues from the by-products plant, mixed them after crushing with a small amount of a cheap protein source such as gram, a little oilpress cake and some molasses. The product was rolled into balls and fed as a regular part of the diet in various proportions to groups

* *Florida Agr. Expt. St. Bull.* 275, 1-26, 1935.

of cows and buffaloes. Control groups were maintained on a diet in which the dried citrus pulp had been replaced. Generally speaking, the cattle thrived well on the citrus feed, had good appearance and gave good yield of milk. Another method of reducing citrus waste for use in stock feeds is that of the garbage or Beccari system of fermentation. The seasonal production of large quantities of waste fruit followed by months of non-production, however, make the fermentation processes difficult to adopt. The Beccari system of fermentation has one advantage, i.e. if the fermented mass cannot entirely be taken off for feeding cattle, it may be employed as a valuable source of humus for sandy soils.

PEACE AND WAR OBJECTIVES OF BRITISH AGRICULTURE

THE twentieth in the series of reports from the Select Committee of the House of Commons on National Expenditure, first set up in 1939, was published last week as the sixth report of this session. It is a plea for effectiveness and forethought in the policy of the Ministry of Agriculture. In peacetime, as a farmer once put it, 'grass is the biggest and most important crop in British agriculture'; more than three-quarters of farm lands, apart from 'rough grazings', are either wholly permanent grassland or rigidly divided into permanent grass and arable; and the traditional policy of British farming is to rear animals on grass and cheap foreign feeds. In wartime, the scene must alter; and the task of wartime agricultural policy is to father the necessary transformation.

It is well to insist on the difference in aim between peacetime and wartime agricultural policy, since no task is more delicate than to strike a balance between present necessity and possible future harm. In peacetime, the object of a sound agricultural policy should be to maintain a healthy farming industry in this country without either substantially increasing the cost of the people's food or harmfully disturbing the flow of foreign trade on which the wealth of the country so largely depends. It may be entirely sound in peacetime to use methods of cultivation that produce less food per acre if to do so is more profitable for the farmer and less expensive to the consumer; that, indeed, has been the whole trend of development of British agriculture these hundred years. But in wartime, the sole object is to produce the greatest volume of food for human beings of which the land of the country is capable. The cost of obtaining this output should be a minor consideration; as the Select Committee points out, there are two needs for the expenditure of public funds: 'first, the need to establish a spirit of confidence in order to get the maximum productive effort out of the farming industry; and secondly, the need for expenditure to restore the fertility of the soil.'

This emphasis on the restoration of fertility illustrates one of the respects in which peacetime and wartime requirements march together. In many ways the standards of pre-war farming in this country were not high; and any increase in the efficiency of farming will be of benefit after the war as well as in the present emergency. The new minimum national wage for agricultural labourers of 48s. a week for men will permanently increase the technical efficiency of the industry, even though it will inevitably make it harder for the British farmer to compete with imports. The farm-to-farm survey that has been made in every country, sorting out the farms well, moderately, or badly farmed, will also serve a double purpose, an instrument of emergency administration now and a guide to policy later. There are enough matters of common concern to war and peace to justify the Select Committee's suggestion that the time is ripe for a 'more comprehensive plan' than hitherto, a 'sort of charter' for farming.—'Farming for the Nation', *The Economist*, 29 March 1941.

PYRETHRUM IN KASHMIR

By M. R. Fotidar, B.Sc. Ag. (Punj.), M.S. Hort. (Calif.)
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In 1937 the production of Pyrethrum in India was considered by the Imperial Council of Agricultural Research. Sir John Russell, who was present at the meeting of the Advisory Board, stated that pyrethrum could be grown in tropical, sub-tropical and temperate climates. The Council recommended that a coordinated experiment should be carried out at suitable centres in the country with a view to finding out whether pyrethrum could be economically produced. Accordingly, the Imperial Council of Agricultural Research secured seeds of *Pyrethrum cineraraefolium* from the Director, Plant Pathological Laboratory, England, and distributed these seeds among the provincial Governments and constituent states for trial, in Kashmir, among other places.

This was how the author undertook the experiments in cultivation of pyrethrum in the autumn of 1937 under the auspices of the Imperial Council of Agricultural Research. This is the third year of the plantation. The harvest of 1940 yielded about 22 seers of seeds besides half a maund of dried flowers for experimental purposes.

Description

Pyrethrum cineraraefolium ordinarily resembles the field daisy, particularly the flower, which is similar in size, shape and colour. The plant is perennial and grows 18 to 20 in. high. Stems are unbranched and slightly hairy. Leaves are petiolate and finely cut. The flower heads consist of rounded receptacles, a straw-coloured involucre composed of three rows of scales and a disc containing numerous yellow flowers with a circle of yellow or cream-coloured ray flowers. The ray florets are ligulate pistillate with cream or white coloured corolla. These florets are delicately veined and exhibit three teeth at the tip. The disc florets are yellow, tubular, perfect and have each a five-lobed corolla borne on the ovary. The flowers vary from 2 to 6 mm. in diameter.

In the late autumn of 1939 and during mid-winter after the snowfall, experimental planting was done at eight centres in the Valley (5,200 to 5,500 ft. altitude) under different soil conditions, both irrigated and unirrigated. The soil varied from light loam to clay, *barani* (rainfed) lands, *Karewas* (plateau dry lands), rice wet lands and land under fruit trees. This was done with a view to finding out suitable conditions under which pyrethrum could be grown successfully and at the same time economically, and also the minimum requirements of water and soil fertility. At three centres out of these eight manurial experiments were laid out for the trial of farmyard manure and ammonium sulphate. Before 1939, experiments were made on viability and germination of seeds, methods of planting in the field, time of seed sowing and plantation and harvesting for seed and dried flowers. The preliminary results of all these experiments have thrown light on the possibilities of this plant for its insecticidal value as a cash crop in Kashmir. The observations on the experiments so far carried out are as follow:

Soil conditions

The plants thrive well in light soils. In such soils, over 500 flower heads were borne on one bush. Heavy soils have not been found suitable inasmuch as the bush does not grow and a large number of plants die in course of time chiefly as a result of slow drainage of rain or irrigation water.

The crop needs well-drained fields preferably with a slight gradient. If there is any waterlogging in any portion of the field owing to local depressions where rain or irrigation water stays on for more than a day or two, all the plants in such portions or fields die as a result of root rot.

The germination of seed is highest in September-October. Seed sown before September does not germinate well, whereas seed sown in April also has a fair germination. Before the seed is sown, the seedbeds should be prepared a season ahead so that during this interval it could be made free of weeds by repeated interculture. One pound of seed was sown in a bed 20 ft. by 6 ft. The seed may be evenly broadcast on a slightly raised bed and lightly raked after a dressing of half an inch of well decomposed fine leaf mould or sweepings. During the last year, we obtained 15,000 seedlings per lb. of seed which is less than 1 per 1,000 when sown in the open fields. This year, experiments have proved that when matured flowers are harvested individually by selection, we can get about 50 per cent germination in sheltered seedbeds or trays. So far the seeds have remained viable after two years of storage under ordinary conditions.

Best planting season

In about six to seven weeks the seedlings are fit for planting and those left to overwinter in the seedbeds make little growth during the winter season. The best planting season is mid-October to end-November provided bucket irrigation is possible; otherwise planting in early spring after the snowfall or during the spring rains in puddle is advisable. Seedlings can be planted any time during the summer in irrigated lands. Ordinarily in such plantations a large number of seedlings die during this season.

Autumn planting will need more than one irrigation. If the spring is dry, one irrigation is essential. Too much irrigation or incessant rains damage the crops considerably. In fact, not a single plant thrives if the land is wet for a considerable period during its active growth. The seedlings should be planted one and a half feet apart in each case. For rapid multiplication the existing one-year-old bush can be subdivided and planted. By adopting this method, one can, on an average, multiply his field ten times.

Great care has to be taken against the weeds during the first year of the plantation. Once the plants start growing and cover the space, all the weeds underneath are checked automatically. It is therefore advisable to conduct all preparatory tillage during the preceding summer season so that all the weeds are brought under control as far as possible. This should be followed with one or two weedings after the planting is done. During the subsequent years, permanent fields will need one weeding and hoeing during the spring season (April-May). If the weather is dry throughout the summer, one irrigation will be advantageous.

The harvesting season starts from the beginning of June. For dried flowers, the first flush is ready during the middle of June. A second flush of late seasoned flowers appears in the fields some time in September-October, but the total yield from the bloom does not exceed a few pounds.

Pyrethrin content

From the literature it has been observed that there is a quantitative increase in the active principle of the flower head from the small bud-stage up to the time of maturity of flowers, more or less keeping pace with the increase in weight of the flowers and rising to a maximum when these come to maturity, that is pollination time. The mean percentage of pyrethrin falls after this period corresponding with the rapid increase in weight of the head when the seed is formed. This fall in the percentage after pollination is not due to any weakening of the pyrethrin content in the flower head, but to increase in the weight of the flowers after pollination without a corresponding increase in the pyrethrin in the flower head. Thus it appears that to obtain the best insecticidal value, the flower should be picked as soon as it is matured, before the formation of the seed.

From a field with a fairly good standing crop planted in rows 1½ ft. apart 300 lb. of dried flowers are obtained during the second year of plantation.

Seed production

For seed production, the flowers should be fully mature and they should be retained up to the end of July. Even then, to secure good viability, great care should be taken for selection of mature heads. On enquiry, the

Director, Malaria Institute of India, has informed the author that the parts of the flowers remaining after seed extraction and leaves are of no value. However, specimens are being sent for determination of insecticidal properties.

Observations on manure are yet incomplete. Preliminary observations have indicated that rich soils produce large-sized bushes with a smaller number of flowers. Soil rich in humus is unsuitable. This was particularly true when the seedlings were planted in spare seedbeds after the removal of seedlings. Such seedbeds are always heavily manured to ensure rapid growth of seedlings.

The plant has so far done well as a cover crop in a young, growing orchard.

Samples analysed

Samples of flowers from the produce of 1939 were analysed by the Malaria Institute of India and the Imperial Agricultural Research Institute, New Delhi. The biological test conducted at the Malaria Institute has proved the product as good and as efficacious as that from Kenya. The pyrethrin contents were ·95 per cent. The analysis at the Imperial Agricultural Research Institute found some crystalline substance after extraction not present in the flowers from Kenya or Coonoor. To find out other particulars about these crystals, fresh specimens have been despatched to the Institute as well as to the Rockefeller International Health Division, Coonoor.

In our own entomological laboratory, four gallons of insecticides—mineral oil solutions—were prepared and the product was found efficacious against mosquito adults and aphids.

Small samples of five other varieties, *Pyrethrum roseum*, *P. Parthenium*, *P. cineraria*, *P. carneum*, *P. leucopiloides*, have also been received from the Imperial Council of Agricultural Research. Out of these, the first two, viz. *P. roseum* and *P. Parthenium*, only have been successful. All the same, these species did not compare well with *P. cineraraefolium*. Samples of these varieties have been sent for biological and chemical tests.

Prospects for pyrethrum

His Highness' Government have taken necessary steps for the extension of pyrethrum cultivation in the state. *Pyrethrum cineraraefolium* has been notified as a reserved drug plant, and unauthorized cultivation has been prohibited with a view to maintaining the quality of the crop. The Forest Department is utilizing all suitable Government land and has taken private land on lease to the extent of about a thousand acres in the first year (1940-41), and necessary steps are being taken for planting this area. Side by side, the Department of Agriculture has also extended its experimental area to over 50 acres in Government gardens. This year, besides producing large quantities of seed, a few maunds of flowers were sold in the market. During the year, about 200 acres are expected to be in the second year of plantation, and within the next two years or so we expect to produce over 300,000 lb. of dried flowers.

SOLAR TREATMENT OF WHEAT LOOSE SMUT

By J. C. LUTHRA, M.Sc., D.I.C. (LOND.), I.A.S.

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MANY of the diseases of farm crops, which are of great economic importance on account of their widespread occurrence and serious damage that they cause, belong to the smut fungi (*Ustilagineæ*). They mostly affect cereals, millets and sugarcane. Among the cereals, the wheat crop is extensively attacked by loose smut. Wheat is a staple crop of the Punjab, United Provinces and Sind.

Rs. 60 lakhs lost yearly

In India, the area under wheat is about 35 million acres and the total produce amounts to 10 million tons. India occupies the third place among the world's wheat-producing countries. Wheat is of importance both for export and local consumption of its grain as food and its straw for fodder. Of the smut diseases of wheat, loose smut (*Ustilago tritici*) is most serious and has been receiving the greatest attention with a view to control. It occurs wherever wheat is grown both in the hills and plains. In the Punjab, the incidence of its attack has been observed up to 30 per cent in many fields, and at a moderate estimate, the monetary loss to cultivators due to this disease would amount to £400,000 (about Rs. 60 lakhs) every year. In view of such a heavy recurring loss, the protection of the wheat crop from loose smut has become a matter of necessity.

But with regard to control measures, the limited means of the Indian farmer and his lack of education are the factors which would determine the kind of methods to be adopted for the purpose. In the first place, his holdings are small and if the crop is damaged by disease, his scanty income is further curtailed and it is very difficult for him to incur expenditure to save his crop. The methods of control must be such as he can employ. In a Mycological Conference held in London it was said that 'control measures suitable for the small farmer must be reasonably efficient, exceptionally cheap and extensively simple and require materials and apparatus readily available. As long as one of these essential requirements was not met, the method was useless.'

In this article an account will be given of a new simple method discovered by the writer, which requires the application of only the sun's heat to eliminate the loose smut infection from wheat grain.

Life-cycle of the causal fungus

The life-history of the causal fungus (*Ustilago tritici*) of loose smut of wheat and the manner in which the disease is perpetuated are well known. It will suffice to give a brief account of it here. The disease commences its attack through the flower. Its symptoms are not noticeable until smutted ears appear. At this stage spores borne on the black heads are scattered by the wind in the wheat field and some of them are carried to flowers of healthy ears. They germinate on the flower and the germ tubes, penetrating through the style, enter the ovary. The hyphæ thus formed branch and give rise to a mycelium, which is deposited in the developing grain. The fungus lies dormant in the mature wheat grain. When the grain is sown and germinates, the mycelium also becomes active and grows with the host plant. The fungus does not cause any injury to the tissue of the host. At the stage of earing the hyphæ branch extensively and spores are formed in profusion. The tissue of the ears is killed and is replaced by spores with the result that black heads covered with spores are produced. These spores are spread by the wind, and the life-cycle of the fungus is repeated.

Jensen's hot-water treatment

The value of heat as a sterilizing agent has been recognized for ages. In nature, the sun

Smutted heads of wheat

Healthy heads of wheat

Method of soaking wheat and its removal from the tub of water for exposure to the sun

provides the necessary heat to keep down a number of diseases and maintain sanitary conditions for the safety of human life. The sun is, therefore, reckoned as a great blessing to man in all tropical countries. It is not many years since the rays of the sun have been applied for effectively controlling certain persistent human maladies. In countries which do not have long hours of sunshine, ingenious electrical contrivances are used for producing similar effects of heat and radiotherapy. The use of heat was first made by Jensen in Denmark (1888) in the form of hot water to control loose smut (*Ustilago tritici* (Pers.) Jens.) of wheat. Since then the process has been employed in a modified form to eliminate diseases carried inside or on the surface of the seed. Attempts to use dry heat in the form of hot air were made by several scientists, but they were not successful, as the seed was injured severely. The only case of success is that of cotton-anthracnose for whose control the cotton seed was heated to 212°F. for 26 hours. The pink boll-worm of cotton has also been successfully controlled by exposing the seed to a temperature of 124°F. for killing the larvæ. Special heaters have since been invented for this purpose. In India, the exposure of cotton seed carrying larvæ of the pink boll-worm to the hot sun in May and June has also met with much success in achieving this object.

Jensen's hot-water treatment, although very effective in controlling seed-borne diseases, particularly the loose smut of wheat, has been found very cumbersome in actual practice and also risky for its liability to injure the seed. Since its discovery, efforts have been made to simplify it. Excepting some modifications with regard to duration of pre-soaking in water and the range of temperature, there has been little change in the essential feature of the method and it is still difficult of adoption by unskilled farmers. A great difficulty has been experienced in the use of this method even on Government farms for producing smut-free wheat seed. A need was felt for a method that would be fit for use by farmers without involving much cost and labour. The use of the sun as a cheap source of lethal heat in place of hot water to kill the smut fungal organism in the seed was thought of as a possibility. Experiments were, therefore, started to investigate this new line of work.

The new method

The investigation was commenced by the writer at the Agricultural College and Research Institute, Lyallpur, in 1929. Lyallpur is the most important town of the Lower Chenab Colony which is a very prosperous canal-irrigated tract of the Punjab. The climate of Lyallpur is extremely hot in summer and very cold in winter. The maximum temperature in the shade goes up to 120°F. in the hot weather. In winter, the temperature is sometimes below the freezing point. The temperature recorded in the sun on an ordinary black bulb thermometer in the months of May and June has been up to 133°F., while on a black bulb vacuo-thermometer it has been registered up to 170°F. The experimental work was divided into two stages. The first step was that of pre-soaking the seed in water. In view of the findings that dry heat is ineffective in controlling such diseases and also causes serious injury to the seed, previous soaking as a preliminary operation was considered essential. In addition to making the seed readily permeable to penetration of heat, moisture renders the fungal organism inside the seed more susceptible to its lethal effect. The second stage of the process was exposure of the pre-soaked seed to the hot sun. A number of combinations of several hours of soaking and varying periods of exposure to the sun were planned out. The various trials consisted of (1) 2 hours soaking, 1 hour exposure, (2) 3 hours soaking, 2 hours exposure, (3) 3 hours soaking, 3 hours exposure, (4) 4 hours soaking, 3 hours exposure, (5) 4 hours soaking, 4 hours exposure. Of all these combinations, the one consisting of the soaking of the smutted seed for 4 hours in water and exposure of the steeped seed to the hot sun for 4 hours or more in order to dry it completely brought about complete elimination of the disease. In the experiments carried out, the untreated wheat gave rise to 5 to 15 per cent smut in different samples and the treated lot produced a perfectly healthy crop. Germination percentage was 98 to 100 and the grain was not impaired in any way. The figures of outturn of crops raised from treated

and untreated seed have been examined statistically and the data prove that there is no adverse effect of the sun treatment on the yielding capacity of the grain.

Simple, cheap, efficacious

The seed treated in the sun in May and June can be stored, taking the usual precautions for protection from attack of insects, and sown in November. Germination tests of samples of treated seed made during the sowing season have shown that there is no deterioration of its viability during storage. Further, it is proved by experimental data that when the weather in July, August and September is dry and the temperature is about 104°F., wheat seed can be treated during these months as well with as complete control of smut as in May and June. But sometimes, on account of prolonged monsoon rains, the weather after the 15th July is moist and the temperature is not high enough to eliminate the disease fully from the grain. On account of the uncertainty of suitable weather in later months, it is recommended that the solar treatment should be applied in May-June or even in July before the rains start, and the treated seed kept in store till required for sowing.

The method has no doubt its limitations. Strong sun is the essence of the process. But some experiments carried out in sub-montane regions support its extension even to moderately hot localities. At Gurdaspur, situated near the hills, the treatment was conducted in July when the temperature in the shade was only 102°F. The crop raised from untreated seed had 18 per cent smutted heads, while the treated one contained only 0·3 per cent of them. It resulted in a heavy reduction of the incidence of the disease.

The solar heat treatment has proved very effective in controlling the disease. It is also economic and safe in its bearing on the value of the seed. It furnishes an example of extreme simplicity of a control measure combined with cheapness and efficacy. The method is largely in use among cultivators. It has really satisfied a demand for the type of control measures best suited for farmers.

THE BREED IS GREATER THAN THE BREEDER

IMPROVEMENT, improvement, improvement! That is what is looked for in the work of these (breed) societies, sufficiently popular to attract to their ranks up-to-date breeders, who are sufficiently interested to work out some scheme of improvement and stick to it. As an example take the case of the Southdown Sheep Society, which really had its being in one man, John Ellman of Glynde, the 'father' and the improver of the breed, taking in hand a hill sheep of poor form and little quality, but showing so much promise that a practical farmer and, as it afterwards proved, a great sheep-breeding genius soon found he was in a fair way to produce a breed of sheep so full of quality, not only of meat but wool, and so prepotent that rams of the breed used on ewes of other breeds always made for improvement and for grading up.

In the first instance, undoubtedly the breeder, or the improver, was more than the breed, inasmuch as he made something out of nothing and brought into being a breed, and by that I mean a pure breed, where none before had existed. While the hand of this improver was moulding the breed, and while he was producing a type that was needed and that had not yet attained to popularity, this man was 'greater than the breed'; but once he had established the breed, and it became recognized and was taken up by other breeders, then the breed was greater than the breeder, even though he might be its founder. The purpose that lies behind the very existence of breed societies is the determination to perpetuate a breed, to attract to its ranks all those who can see possibilities in it, who are likely to further its interests and who take an intelligent interest in its improvement, and that quite apart from any financial benefit they may expect to reap from it.—E. WALFORD LLOYD in *The Field*, 29 March 1941.

INSECT STUDY AND ANIMAL DISEASE CONTROL

By B. C. Basu, D.Sc.
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THE popular term 'insect' does not require much detailed explanation. The body of this invertebrate, in the adult stage, is divided into three distinct sections, the head, the thorax and the abdomen; a single pair of antennae is present; and the thorax carries three pairs of legs and usually one or two pairs of wings. Mosquitoes, flies, horse flies, bugs, lice, sandflies, fleas, butterflies, moths, bees, beetles and grasshoppers are familiar examples of this section of the animal kingdom.

Loss caused by insects

Approximately 500,000 species of insects have so far been described, and they represent seven-tenths of the total number of species in all the groups of the animal kingdom taken together. Thus an individual worker on entomology is, as it were, like one picking up a few shells on the vast seashore of insect life. It would not be an exaggeration to say that in the history of man, insects have been responsible for more loss of life and destruction of property than that caused by wars, floods, earthquakes, fires and famine combined. The annual monetary loss caused to India through insect pests has been assessed at about Rs. 200 crores, while they are believed to be responsible for a human mortality of over one and a half millions a year. It has been estimated that the total annual loss in the U. S. A. occasioned by insects to animal and their products amounts to Rs. 130 crores.

Today, however, one notices a remarkable change in the outlook of both scientists and laymen regarding the relationship of insects and their allies, ticks and mites, to the welfare of men and animals. Until the beginning of the twentieth century, they were regarded merely as causing annoyance or direct injury to man and to his livestock and crops. Now it is realized that they disseminate some of the most important human and animal diseases. The recognition of this fact has revolutionized the methods of control of certain diseases of men and animals and has become an important weapon in the fight for the conservation of health. Modern knowledge, however, did not come unheralded. Various references in the writing of the ancients indicate that, even before the time of Christ, there was a belief that insects had some connection with the spread of disease, for instance that mosquitoes were concerned in the transmission of malaria.

Discovery of the microscope

But the writer feels that most of these were lucky guesses, since, indeed, only a little over a century ago, if the wisest doctor in the world had been asked: 'What is the cause of mumps?' or 'How do people die of rabies?' his reply would have been: 'A mumpish evil spirit has got into you—the dog that bit you was possessed of the devil.' But thanks to a Dutch shopkeeper, Leeuwenhoek, the first of the microbe hunters, whose discovery of the microscope in 1695 opened a new chapter in the history of parasitology, men may now peep into a fantastic subvisible world of little things—creatures that previously had lived, had bred, had battled and had died completely hidden from and unknown to men from the beginning of time. Beasts these were of a kind that ravaged and annihilated whole races of men and animals. Then in 1877, came the remarkable discovery by Pasteur, the French scientist, of the fact that disease is caused by microscopic 'germs'.

Before going on to show how the study of insects has influenced the control of animal diseases, it is necessary to trace briefly the history of the development of our knowledge regarding their part in the transmission of disease. In doing so, it would seem hardly desirable to separate the medical from the veterinary field, since they are so closely linked together.

Modern discoveries

The first discovery of fundamental importance in the field of medical and veterinary entomology was that of Sir Patrick Manson, a British scientist, who in 1878 observed the development of a worm belonging to the *Wuchereria* genus (the causative organism of filariasis) in a species of mosquito (*Culex fatigans*) in China and finally proved that this insect is the carrier of the disease.

The second great discovery in this line was that of Theobald Smith and F. L. Kilborne of the Public Health Service, U. S. A., who in 1893 proved beyond doubt the transmission of a certain protozoan parasite (the causative organism of Texas cattle fever) from animal to animal through the agency of the cattle tick, *Boophilus annulatus*. This, however, did not attract the attention it merited. They demonstrated the fact of the transmission but were not able to show the development of the parasite in the ticks. The life-cycle of piroplasms in ticks was first demonstrated in India, in connection with dog tick-fever, by Christophers in 1907.

In 1895 Sir David and Lady Bruce, working in Zululand under conditions of incredible hardship, discovered the transmission of Nagana by tsetse flies and also worked out the transmission cycle of the causal agent of the disease. This was a discovery of enormous importance and it paved the way for a number of subsequent discoveries in this field. Then came the epoch-making discovery of the role of mosquitoes in the transmission of human and avian malaria.

Malaria research

In 1898, Sir Ronald Ross discovered, in India, the transmission cycle of bird malaria in culex mosquitoes and stated that a similar cycle would apply in the transmission of human malaria through the agency of anopheline mosquitoes. In the same year Grassi, in Rome, demonstrated the transmission of human malaria by a mosquito technically known as *A. maculipennis* and experimentally infected a volunteer by mosquito bite. The year 1898 also witnessed the discovery by Simond of the fact that human plague was transmitted from rat to rat through the agency of infected fleas.

In 1900, the First Yellow Fever Commission, working in Cuba, proved the transmission of Yellow fever by a mosquito technically known as *Aedes aegypti*. In 1902, Graham worked out the transmission of Dengue fever by the same mosquito (*Aedes aegypti*).

In 1903, Marchoux and Salimbeni proved that fowl spirochaetosis is a tick-borne disease and that the common fowl tick (*Argas persicus*) is responsible for its transmission. In 1904, Dutton, Todd and others discovered the transmission of African relapsing fever by the tick technically known as *Ornithodorus moubata* and in 1906, Ricketts, working in Montana (U. S. A.), proved that a tick (*Dermacentor andersoni*) is the principal vector of Rocky Mountain spotted fever.

Flies of the family of Tabanidae have been found, by a number of workers, to be responsible for the mechanical transmission of surra. In 1915, Mrs Adie worked out the developmental phases of *Haemoproteus columbae*, the causative organism of pigeon malaria in the biting fly, *Pseudolynchia maura*, which acts as the invertebrate host of the parasite.

In 1921, Francis Mayre transmitted Pahvant Valley plague from rodent to rodent by the tabanid fly, *Chrysops discalis*. In 1926, Blacklock reported *Simulium damnosum*—the buffalo gnat, as the transmitter of onchocerciasis.

In 1930, Basu transmitted chicken cholera through the agency of the fowl tick, *Argas persicus*. In 1933, Kelser successfully transmitted equine encephalomyelitis by the bite of the mosquito (*Aedes aegypti*). To this list the mechanical transmission of anthrax, typhoid, cholera, dysentery, tuberculosis, etc. by house flies, worked out by various investigators, may be added. Even then the list is far from complete.

Survey of Indian animal diseases

Little is yet known regarding vectors of animal diseases in India, but devoted workers are already toiling in this field. Years of work will, however, be necessary before anything like a complete survey can be accomplished.

Mention may here be made of the numerous forms of disease caused by direct injury to man and animals, such as those due to mange, scabies and warble flies, the causal agents

involved in the first two conditions being various species of mites. A knowledge of the life-history and habits of these pests has now resulted in the development of effective methods for their control by the application of various forms of dressings on the affected part of the hosts. Side by side with investigations into the methods of disease transmission, scientists have from time to time taken up the question of control of insects and their allies and this necessarily has led to a study of their life-histories and habits in order to ascertain at which phase of their life they can be conveniently tackled by the application of various insecticides, dips and dressings, attractants and repellents, fumigants and food poisons, traps and screens.

These methods for the control of insect pests and their allies can, however, achieve only a temporary success, since the methods themselves require repeated application, with considerable expenditure of time, labour and money: permanent control should, when possible, be aimed at, as being more effective and less expensive in the long run. Thus a small collection of standing water can be drained or otherwise handled with little expense, whereas its treatment with repeated application of insecticides involves great expense and inconvenience. The common house fly, a source of so much annoyance, is commonly combated with insecticides, sticky fly paper and screens, when perhaps the proper disposal of a few piles of horse-manure would give more permanent relief.

Prospects of biological control

Lastly, a reference should be made to so-called biological control of insect pests, which owes its origin to the fact that a great many injurious insects are themselves attacked by other parasites and predaceous species. Curiously enough, in spite of the obviously potential value of this method of control, it has received relatively little attention, though it promises, before long, to assume a position of paramount importance in applied entomology.

Experience in the field has proved that for insect-borne diseases, insect control is the safest and the surest method, since 'prevention is better than cure'. One thus notices that wholesale dipping of cattle is at the present time practised in certain parts of the United States of America and as a result Texas fever, which once threatened myriads of American cattle, is no longer a matter for concern in that continent. Similarly, human plague is today practically unknown, yellow fever is almost completely controlled and malaria has become a preventable disease.

RURAL RECONSTRUCTION IN HYDERABAD

By Raziuddin Ahmed, H.C.S.
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A SCHEME for the rehabilitation of the rural areas was approved by H. E. H. the Nizam's Government in 1347F (1937-38). A Central Rural Reconstruction Board has been constituted under the chairmanship of His Excellency the President of the Executive Council. It has as its members the Hon'ble Members of the Executive Council, the Director-General, Revenue, the Secretary, Constitutional Affairs, the Subedars and all the Heads of nation-building departments, viz. Cooperation, Agriculture, Veterinary, Education, and Medical and Sanitation. Each district has a board with the First Talukdar as president and officials of the interested departments and some local non-officials as members. Similarly, there is a board in each taluka with the Tahsildar as chairman and some of the local officials and non-officials as members. Sixteen district councils and seventy-six taluka councils have been set up and a village in each taluka has been selected for intensive treatment with a cooperative rural reconstruction society of its own.

Individual technique

As conditions vary from district to district, rather from village to village, it is considered advisable that each village should be left free to evolve its own technique suited to its own peculiar needs and requirements. But it is not an uncommon experience that in the absence of any well-defined policy the movement suffers from lack of continuity and consistency. May be that in one year the villagers may be devoting all their attention to road making and in the next year they may be seen spending their energy on sinking wells or digging soakage-pits or sports or opening ventilators. It was therefore considered desirable that some programme should be chalked out with a definite policy, at least in respect of such essentials as may appear to be common problems all over the Dominions. The Central Board of Rural Reconstruction has emphasized that the economic improvement should precede other activities and therefore the district and taluka councils should keep the agricultural development of selected villages in the forefront of their programmes. It was made clear that things should be looked at with a wider angle of vision and programmes chalked out after a careful survey of local conditions so that whatever line of action is decided upon it must give results of lasting and permanent value rather than spectacular gestures. It is essential that the villager is taught among other things first the benefits of improved farming and animal husbandry, organized sale and purchase of farm produce and above all self-help and thrift.

So far 107 rural reconstruction societies have been registered with a membership of 9,588. They had collected Rs. 10,100 by way of subscriptions in 1348F (1938-39) and spent Rs. 5,402 on various rural reconstruction activities.

Of the 107 villages selected for rural reconstruction, 76 have cooperative credit societies and efforts are being made to organize such societies at the remaining villages as well so that villagers should be able to get cheap but controlled credit through these cooperative societies. The working capital of these cooperative credit and thrift societies improved from Rs. 2,15,029 in 1347F (1937-38) to Rs. 2,50,137 in 1348F (1938-39) while the owned capital increased from Rs. 1,10,174 to Rs. 1,29,411 in the same period.

Improved seeds distributed

Improved seeds other than cotton seeds recommended by the Agricultural Department amounting to nearly 946 maunds were distributed among 1,803 members of the rural

reconstruction societies. Of the improved varieties of cotton seed Gaorani 6 has definitely established itself on the field as well as in the markets of the Nanded district. The cooperative sale society at Nanded has recently been converted into a Cooperative Cotton Union in order to distribute and develop this particular strain on cooperative lines. The commercial benefit of this seed which was sown on 110,000 acres in the Nanded district is evident from the fact that it fetched an average premium of Rs. 21 per candy of 480 seers in 1348F (1938-39) over the price of the local *bani* (long staple).

As regards manure the Cooperative Department is trying in coordination with the Agricultural Department to carry on effective propaganda in order to induce villagers to dig manure pits, collect all village refuse and cowdung and to utilize all waste matter as manure. The use of night-soil as manure is also being propagated and villagers are appreciating the idea though with reluctance. So far 2,599 manure pits have been dug at the rural reconstruction centres and 350 maunds and 62 bags of artificial fertilizers distributed, the latter chiefly for sugarcane cultivators in villages under the Nizamsagar.

Iron ploughs and chaff-cutters worth about Rs. 3,000 have been purchased by the rural reconstruction societies during the last two years. These implements are given on hire at a small rate to members, who have not got improved implements of their own.

Cattle improvement

To improve the stock of cattle 17 stud bulls of good breed, which in most cases have been given free by Government, are maintained at as many rural reconstruction centres. During the last two years 267 cows were covered by these stud bulls and 3,109 scrub bulls were castrated. Vaccination of cattle is also getting popular at these centres as is evident from the fact that 15,400 in 1347F (1937-38) and more than 17,000 animals in 1348F (1938-39) were vaccinated as a precaution against various diseases.

To help cultivators in obtaining the best price for their produce, cooperative sale societies are being organized and Government has appointed a Sales Officer to develop this side of the rural economy. Government has also kindly agreed to give a grant of Rs. 20 to Rs. 30 per month for the first three years to enable each society to employ a clerk so that it may soon be able to build up its business. Sale societies have been promised further help by Government in the shape of loans repayable in 15 years at 3 per cent interest which in each case will be advanced to the extent of Rs. 5,000 for the construction of godowns. Twenty-five per cent of the loan thus advanced will be treated as a free grant and this concession will be extended to those societies also which will construct godowns with their own money. There are in all eight cooperative societies with a working capital of Rs. 48,400 and the value of produce sold through these sale societies by the members of rural reconstruction societies in 1348F (1938-39) was Rs. 2,432. A comprehensive scheme for organizing rural banks, a special feature of which will be linking of credit with marketing, is under consideration. It is hoped that the proposed organization will enable its members to sell all their produce at a profit on cooperative lines.

Subsidiary industries encouraged

Efforts made to add to the income of the agriculturists through subsidiary industries have been fruitful. Figures collected at the rural reconstruction centres show that the value of ghee sold in 1348F (1938-39) was Rs. 28,000 while income from poultry was about Rs. 5,000. Planting of fruit trees is also being encouraged and at villages adjacent to towns and cities, where they have marketing facilities, cultivators are induced to grow vegetables on a larger scale. Some of the rural reconstruction societies have arranged to get good vegetable seeds from well-known firms for supply to their members.

Along with better farming and better business, better living activities also show appreciable improvement. Water supply of several villages has been improved and in all 33 new wells were sunk at a cost of Rs. 7,557, most of which were contributed by villagers in the shape of free-labour. A number of step-wells were converted into draw-wells making them

more hygienic. Twelve miles of village roads at the rural reconstruction centres were improved at a cost of Rs. 30,215 spent from Local Funds to which the villagers contributed free labour worth about Rs. 3,000. The number of children vaccinated was 5,110 while that of persons inoculated was 2,106. In 633 houses more than 1,100 ventilators were opened and the total number of soakage-pits stood at 1,737.

Desire for education

The desire for education is apparent at all the villages selected for rural reconstruction and the members now appear to be keen on sending their children to school. The strength of the village schools was 6,181 boys and 852 girls in 1348F (1938-39) while the number of adults that attended night classes at various centres was 579. Adults are not only taught how to read and write but are also trained in matters useful in their daily life. Teachers trained in rural reconstruction are posted to schools in the selected villages and they are instructed to speak to the villagers on various subjects, e.g. geography of the village and taluka, improved methods of cultivation, marketing, cooperative principles, thrift, cleanliness and such other topics. The rural reconstruction societies spent Rs. 383 out of their funds towards pay or allowances to teachers who held night classes for adults. Government had spent Rs. 3,641 and rural reconstruction societies Rs. 200 on playgrounds in 107 villages in 1348F (1938-39). Cooperative rallies were held at 59 centres in 1348F where prizes awarded to boys, girls and adults taking part in sports amounted to about Rs. 1,006 in cash and about 25 tolas of silver. Thirteen baby-shows were held at which prizes worth Rs. 200 were distributed.

The Central Cooperative Union has posted 11 propagandists at different rural reconstruction centres who supervise and guide the villagers to work on the right lines. Government has promised that in villages which enlist at least half the number of families as members of the local rural reconstruction society a cash contribution will be made to the extent of one-third of the local cess. It has also agreed to pay conveyance allowance to non-official members of the taluka or district councils for visits to rural reconstruction societies.

Thrift promotion

Promotion of thrift and self-help are the watchwords of the rural reconstruction campaign. At rural reconstruction centres where they have cooperative credit societies it is prescribed that in addition to shares, which have to be purchased at the time of joining the society and of taking loans, the members should be induced to contribute towards shares at least one rupee a year for every twenty-five rupees, which they pay as land revenue to Government. Further, in order to help small agriculturists to save something from their slender resources grain banks are being organized. They are getting popular, for cultivators find it easier to save something in kind rather than in cash. Fifty-nine grain banks have so far been organized with 1,858 members who stored 920 maunds of grain towards share capital and loaned out nearly 740 maunds in 1348F (1938-39). Assuming Rs. 4 per maund as the average price the value of grain saved by 1,858 members in one year works out to Rs. 3,680. Loans advanced by the grain banks are to be repaid in kind at harvest with interest which is governed by the local rate. In the case of loans taken for sowing purposes it is prescribed that the interest should not be more than half of the usual rate. A large portion of the profits thus earned is redistributed amongst members as bonus, in proportion to their borrowings, which is ordinarily added to their shares.

What the Scientists are doing

SEED TREATMENT AND CROP OUT-TURN

THERE is now no doubt about the beneficial effects of seed treatment for the control of certain seed-borne diseases; but the question is if the seed treatment has any stimulating effect on the yield if healthy seeds are treated. In other words, from the farmer's point of view the question is: 'Is it a paying proposition to treat seeds even if they are known to be free from disease, or should the seed be treated only when it cannot be guaranteed to be free from disease?' The experience gained during the last four years in the Central Provinces shows that at least in the case of cotton and *jowar* seed treatment increases the yield even when the seed is free from disease.

Need for treatment

Cotton anthracnose in certain years causes considerable damage to bolls. Seeds from infected bolls are also usually diseased but may not be so badly infected as to be incapable of germination. Therefore the danger is that seeds, even though diseased, may be used the following season as externally they do not look much different from healthy seeds. From such infected seeds the seedlings will be diseased and will damp off, and the infection may spread to the neighbouring healthy seedlings. The result is a heavy loss of seedlings, and often resowing has to be done, and still the result will once again be the same. If the seeds are treated before sowing not only is the disease checked when diseased seed is used but the yield is increased even when healthy seeds are sown.

For seed treatment copper carbonate, finely powdered sulphur, commercial sulphuric acid and four proprietory fungicides have been used. The following table shows the percentage of increase in yield per acre when healthy seeds are treated:

—	1936-37	1937-38	1938-39	1939-40
Seed treated with proprietory fungicide A	14·4	27·0	38·3	19·0
" " " B	9·1	20·6	44·6	21·1
" " " C	8·0	13·9	40·3	17·5
" " " D	16·3	25·9	25·9	..
Seed treated with copper carbonate	25·3	24·9	38·9	8·2
Seed treated with sulphur	15·2	29·2	33·7	19·5
Seed delinted with sulphuric acid	8·7	9·9	10·4	..
Control . . .	0	0	0	0

The last four results show that the increase in yield from treated cotton seed is substantial though the percentage of increase varies from season to season. The proprietory fungicides, copper carbonate and sulphur are each added to the cowdung solution locally used for dressing the seed to enable it to pass through drills. One ounce of each of these fungicides and chemicals is used for treating 28 lb. of seed.

Treatment of healthy seed

Jowar seed is usually treated for the control of grain smut and loose smut diseases. *Jowar* seed free from smut infection when dusted either with copper carbonate or finely powdered sulphur or two proprietory fungicides has given better yield than untreated healthy seed. The following table shows the percentage of increase in yield per acre when healthy seeds are treated:

—	1936-37		1937-38	
	Grain	Fodder	Grain	Fodder
Seed dusted with proprietory fungicide A	19·4	9·9	8·1	5·1
" " " D	12·6	9·7	11·3	7·5
Seed dusted with copper carbonate	5·3	6·3	3·2	3·2
Seed dusted with sulphur	11·5	8·3	7·3	4·6
Control . . .	0	0	0	0

The proprietory fungicides were used at the rate of 1 oz. for 20 lb. of seed and copper carbonate and sulphur at the rate of 1 oz. for 48 lb. of *jowar* seed.

These results show the necessity for further trials with other crops.

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EDIBLE SYRUPS FROM MOLASSES

LITTLE success has attended the many attempts made for the utilization of exhaust molasses in the manufacture of confectionery and other articles of human diet, chiefly due to difficulty in the removal of undesirable substances like bitter inorganic salts, large quantities of caramel and other organic impurities present in molasses. Although cane molasses is being used for the manufacture of cattle-feeds, it has not been possible to make it sufficiently pure and palatable for human consumption.

While the consumption of table syrup is very large in other countries, especially in the U. S. A., in India it is limited at present, the chief reason being probably the high price of the imported product. If a cheap and palatable syrup could be placed on the market, its use would become more extensive. Work done at the Imperial Institute of Sugar Technology by Dr K. A. N. Rao has shown that such a product can be prepared by precipitating all the sugars in molasses as lime compounds from which they are subsequently recovered by carbonitation. By this method, it has been possible to recover 80 per cent of the sugars originally present in the molasses. The sugar solution filtered from calcium carbonate is treated with phosphoric acid and lime, or activated vegetable carbons, and concentrated to a syrup of 75° Brix. The syrup obtained has a good taste and is pleasing to the eye. No crystals are deposited even after standing for more than a year.

The results obtained indicate that table-syrups can be profitably manufactured from molasses. The price of the syrup manufactured will depend on the quality required. By concentrating sufficiently, a part of the sucrose can be recovered and the residual syrup will still be suitable for table use. The cost of the syrup after recovery of sucrose will be only a fraction of the price at which it is sold in the market and hence its use could be made popular. It could also be used for other purposes such as preparation of jams and sweetmeats—in fact for any purpose for which a sugar solution is required. Supplies of syrup could be made to the army in barrels and will be a cheap and valuable article of diet.

This syrup can be used for most of the table purposes in place of sugar itself. It is as wholesome and as nutritious as cane sugar itself, perhaps even more so, and an important advantage of this syrup over cane sugar is that its sale is not liable to levy of excise duty.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q: I have been informed that dried *amla* (*Phyllanthus emblica* Linn.) pulp can be used as a source of vitamin C to prevent scurvy. I understood that when fruits and vegetables are dried vitamin C is destroyed. Is *amla* an exception ?

A: Nearly all fruits and vegetables lose their power to prevent scurvy when dried. Of all the vitamins, vitamin C is the most easily destroyed by drying or heating. *Amla* can, however, be dried and yet remain a rich source of this vitamin. There are two reasons for this. First it contains certain tannins which have a protective effect on the vitamin, and secondly its juice is very strongly acid. An acid medium tends to prevent destruction of vitamin C. These factors do not completely prevent loss of vitamin C when *amla* pulp is dried, but they minimize it. It is, however, essential that the pulp should be dried quickly ; otherwise there is considerable destruction. *Amla* powder dried under proper conditions is so rich in vitamin C that one gramme can furnish an adult with his daily requirements of the vitamin. The amount of the vitamin present in the powder is slowly reduced if the powder is exposed to air, particularly in a hot atmosphere, but even after storage for several months it remains a very rich source of vitamin C.

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Q: I hear that shark liver oil is now being produced in India as a substitute for cod liver oil. Is it as good a medicine as cod liver oil ?

A: Cod liver oil is valuable as a medicine because it contains two vitamins—A and D. Doctors recognized its value long before vitamins were discovered. There are many other kinds of fish whose liver oil is as rich or richer in these vitamins as cod liver oil. For example, halibut liver oil may contain 40 times as much vitamin A as cod liver oil and has been much used in recent years for the manufacture of medicinal preparations. Shark liver oil is often ten times as rich as cod liver oil in vitamin A, and about twice as rich in vitamin D, and can therefore be used as cod liver oil substitute. It is very fortunate that a substitute for cod liver oil is available in quantity in India, now that supplies of the latter have been cut off by the war. A great many people in India suffer from deficiency of vitamins A and D and are benefited by taking cod liver oil or cod liver oil substitutes.

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Q: It is asserted that cowdung contains no phosphorus because the phosphates which the cow eats go into her milk. Is this substantially correct ?

A: The statement that cowdung contains no phosphorus is absolutely incorrect. Normally cowdung contains plenty of phosphorus.

When the animal eats a ration, the whole of it is not digested, and as such, part of the phosphorus which is a constituent of the ration is also not digested. This part comes out in the fæces. Part of the absorbed phosphorus is metabolized and is used up in various ways such as enriching the blood-stream, formation of phospho-proteins and phospholipins, etc. Some amount is excreted in urine and a part comes out in the milk, so that it is also not true to state that all phosphates which the cow eats go into her milk.

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Q: Will you kindly let me know where I can undergo training in goat-breeding ? I should also like to know the rules

and regulations regarding the award of the diploma in Dairying, Poultry and Cattle-farming.

A: Facilities for practical training in goat-breeding are available at the Mission Goat Breeding Farm, Etah (U. P.), and the Government Cattle Farm, Hissar. You may address the Manager, Mission Goat Breeding Farm, or the Superintendent, Government Cattle Farm, Hissar, direct on the subject.

As regards rules for post-graduate courses in Dairying, Poultry-husbandry and Cattle-breeding you may write to the Imperial Dairy Expert, Bangalore, the Director, Imperial Veterinary Research Institute, Mukteswar, and the Director, Imperial Agricultural Research Institute, New Delhi, respectively.

What's doing in All-India

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.), P. A. S. (Class I)
Associate Professor of Agriculture, Punjab Agricultural College, Lyallpur

On account of the protracted drought that prevailed from October to December 1940, the prospects of the *rabi* crops at the beginning of 1941 were gloomy. Light to moderate showers in January and light rain in February, however, proved beneficial to all the standing crops. March was dry and considerably warmer than usual. Hot and dry winds in some parts of the province caused partial drying up and shrivelling of wheat grains. Hail at places in the Jullundur circle caused varying damage.

Crop notes

With the help of rain in January and the following month, wheat made good progress and its general condition was reported to be about 92 per cent of the normal. Canal water supplies were generally sufficient for maturing the cotton crop except in the south where they were insufficient. American cotton suffered from bad opening in some places, but the damage caused was not serious and yields obtained were normal to above normal. The *desi* crop did not suffer from bad opening and the yields obtained were good.

Sugarcane crushing was finished by the end of March. The season on the whole was favourable to the cane crop. Consequently, normal to above normal yields on irrigated and below normal to normal on unirrigated areas were realized.

The condition of the local varieties was satisfactory, but the new blight-resistant variety F8—recently recommended by the Department for blight-affected areas in the province—suffered from a severe attack of wilt, especially in the Mianwali, Jhang, Lyallpur, Ferozepore, Ambala and Hissar districts. Its condition was, however, reported to be quite satisfactory in the Attock tehsil of the Attock district, in parts of the Jhelum, Gujrat, Sargodha and Rawalpindi districts.

The harvesting of *toria* was completed during the quarter. Yields obtained were below normal to normal. The rains received in the month of January and February proved beneficial to all the standing crops. Consequently the condition of other oil-seeds was reported to be 91 per cent of the normal.

Departmental activities

By far the most outstanding event was the holding of Farmers' Weeks at all the headquarters of the Deputy Directors of Agriculture.

As reported on a previous occasion, these gatherings provide opportunities to a large number of cultivators for coming in closer contact with the members of the Agricultural and other Departments and for studying on the spot efforts which are being made to ameliorate their condition.

Members of the research staff also derive considerable benefit from such gatherings as they set up a close relationship between the field and the laboratory so essential to the progress of both.

Staff meetings and refresher courses are also held on these occasions with a view to galvanizing those members of the district work staff who are posted at out-of-the-way places and who, if not given occasional stimulants of this nature, are likely to become slaves of routine.

Green-manuring with guara

It is a well-known fact that organic matter is

the crying need of the Punjab soils. An application of this valuable material in however small quantity brings about very favourable results for crop growth. It is, however, not possible under the present system of farming to get all the organic manure generally required by a farmer. In order, therefore, to meet this pressing demand of the farmer resort has to be made to some other methods. The practice of green manuring with leguminous crops is one of those methods usually adopted by the cultivators. With a view, therefore, to ascertaining a legume suitable for the climatic conditions prevailing in the Punjab, the following leguminous crops were tried at the Lyallpur Agricultural Farm:

Guara (*Cyamopsis psoralioides*)
Sann (*Crotalaria juncea*)
Mash (*Phaseolus radiatus*)
Moth (*Phaseolus aconitifolius*)
Mung (*Phaseolus mungo*)
Indigo (*Indigofera tinctoria*)
Jantar (*Sesbenia aculeata*) and
Arhar (*Cajanus indicus*).

Of all these, *guara* was found to be the best suited crop for our conditions. As the results obtained depended to a very large extent upon the quantity of green stuff buried in, an experiment was conducted to find out the best sowing and burying in time of *guara*. The experiment was started in 1920-21 when *guara* was sown both early and late in the season and was buried in accordingly, i.e. *guara* sown early from the middle of April to the middle of May was buried in in July and *guara* sown late in May or June was buried in in August. The rotation was: wheat (8A)—*toria*—cotton (4F). The results obtained during the period 1923-24 to 1931-32 are recorded below.

The results given here are very interesting. The increase in yield (both in early and in late green manuring) is not so well marked in the wheat crop as it is in the case of the *toria* and the cotton crops. This is believed to be due to the fact that the green stuff buried in was not so completely decayed by the time the wheat crop was sown after green manuring. In the case of *toria* and cotton, however, the stuff appears to have completely decayed and the latter two crops benefited more in comparison with wheat.

Definite results having been obtained, further application of green manuring was discontinued from 1932-33. From then onwards the residual effect of green manuring was studied on all the three crops of the rotation, i.e. wheat, *toria* and cotton. The study of the residual effect was taken up with a view to finding out (1) whether wheat by nature responded less to green manuring or whether a depressed yield was due to the incomplete decay of the green stuff buried in, and also (2) whether the extent to which

Treatment	1923-24 to 1931-32 Yield in md. per acre					
	Wheat directly green-manured	% increase over cultivated fallow	Residual effect on			
			Toria		Cotton	
			Yield	% increase over cultivated fallow	Yield	% increase over cultivated fallow
Cultivated fallow	20·80	..	10·77	..	8·0	..
Early green manuring . .	23·87	14·7	15·22	48·30	12·55	56·9
Late green manuring . .	22·52	8·3	14·32	32·90	10·45	30·6

Treatment	1932-33 to 1940-41 Average yield in md. per acre (Average of three crops each)					
	Wheat (grain)	% increase over cultivated fallow	*Toria*		Cotton	
			Yield	% increase over cultivated fallow	Yield	% increase over cultivated fallow
Cultivated fallow	16·34	..	7·85	..	8·44	..
Early green manuring	18·78	14·93	9·10	15·92	10·87	28·79
Late green manuring	19·16	17·26	8·87	13·0	9·73	15·29

the residual effect of previous green manuring would last. The yields obtained up to date (1940-41) are recorded.

The above results show that of all the three crops in the rotation the cotton crop responds most to green manuring.

Cotton sown and matured during 1940-41 was the twelfth crop after the last green manuring was done in 1929-30. Yields obtained are given below :

Treatment	Average yield in md. per acre of *kapas*	% increase over cultivated fallow
Cultivated fallow	9·07	..
Early green manuring	10·97	20·95
Late green manuring	9·98	10·25

It is indeed very interesting to see that the residual effect continues even after such a long period.

Malta orange studies

Quality of fruit and its time of maturity are the two very important points which a fruit-grower must consider seriously before venturing to plant any fruit trees.

Observations on these characters in various varieties of malta oranges grown at Lyallpur have been made and the results obtained serve as a safe guide for intending growers.

Pineapple malta orange is the most outstanding variety with very thin skin. It is very juicy and sweet but has a fairly large number of seeds. Its best picking season is during the first fortnight of February.

Excellencis, Vaneille and Seville varieties come next in quality and are almost alike in all respects. Their fruit is medium to big in size, the quantity of juice is high and fairly sweet. They possess the least amount of 'rag'. The best picking season for these varieties is the second fortnight of January.

Jaffa and Dulcis varieties are very similar to one another. The fruit is medium to big in size with a fair amount of juice. The skin is fairly thin and the number of seeds per fruit is small. The juice is sweet but the quality, on the whole, is somewhat inferior as compared with the quality of the above-mentioned varieties. The best picking season for these two varieties is the first fortnight of February.

The size of *Mosambi* fruit is medium to big and the amount of juice is quite good ; the rind is medium in thickness. It possesses the largest number of seeds per fruit and is very sweet with hardly any acid blend which almost gives it a taste like the sweet-lime. It is the earliest variety to ripen, and the best picking season is the first fortnight of January.

Valencia (late) has the largest fruit but its juice content is medium to low and the amount of 'rag' is rather high. Its rind is also fairly thick and the juice is rather sour. It is a late-ripening variety and is picked during the first fortnight of March. Hence it fetches a high price in the market as no other Malta varieties are available then.

Punjab students' success

A special feature of the fourth All-India Cattle Show held at the Irwin Amphitheatre, New Delhi, in February this year was a students' cattle-judging contest open to the students of all the veterinary, dairying and agricultural institutes in India. In ll anine

teams as mentioned below participated in this contest:

Punjab Agricultural College, Lyallpur	2 teams
Punjab Veterinary College, Lahore .	2 ,,
Imperial Dairy Institute, Bangalore .	2 ,,
Imperial Veterinary Research Institute, Mukteswar	2 ,,
Agricultural Institute, Allahabad .	1 team

It is gratifying to report that both the first and the second places were won by the teams coming from the Punjab Agricultural College, Lyallpur. The Challenge Shield presented by Messrs Polson Ltd., Bombay, and a prize of Rs 75 was won by the first team of the Punjab Agricultural College, Lyallpur, and the second prize of Rs 50 was won by the second team of the same College. The College and the teams are to be congratulated on their performance.

HYDERABAD

By Mirza Mohiuddin Baig, B.A.

Personal Assistant to the Director of Agriculture, Hyderabad

HYDERABAD is predominently an agricultural area. The prosperity of agriculture depends on the condition of the livestock. The total livestock is reported to be 222,578,350, and land under cultivation is about 28,615,112 acres, on almost all of which bullock power is used. The cash value both direct and indirect of livestock to the state is estimated at about Rs 80·08 crores.

There are some useful types of cattle, viz. Malvi, Krishna Valley, Ongole, Deoni, and there are buffaloes which are the chief source of dairy products.

Dual-purpose cattle

There is a horse and cattle farm at Hingoli and a cattle-breeding farm and dairy at Himayatsagar. The two farms, under the Veterinary Department, are mainly concerned in the production of animals which can be relied on to breed true for high milk yield as well as work. Stock thus bred under controlled conditions is to be distributed to the ryots to improve inferior cattle. A large number have already been pushed on in different tracts of the country where they were desired, such as the Malvi type in the Nizamsagar area and the Deoni in Marahtwara.

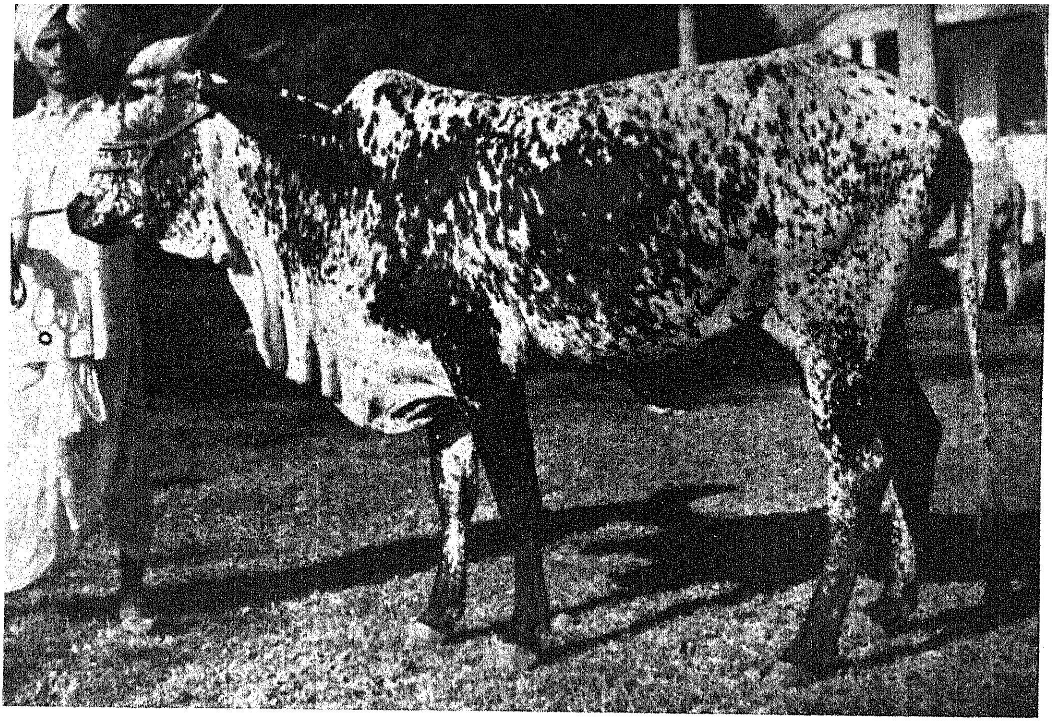
In addition to this, measures such as pedigree registration and establishment of herd books which are very useful in the improvement of stock are receiving attention.

Castration of scrub bulls to prevent promiscuous breeding is also being carried on. The district stallions continue to cater for the service of cultivators' mares to grade horse stock with a view to encouraging the better breeding and rearing of horses.

Obscure diseases

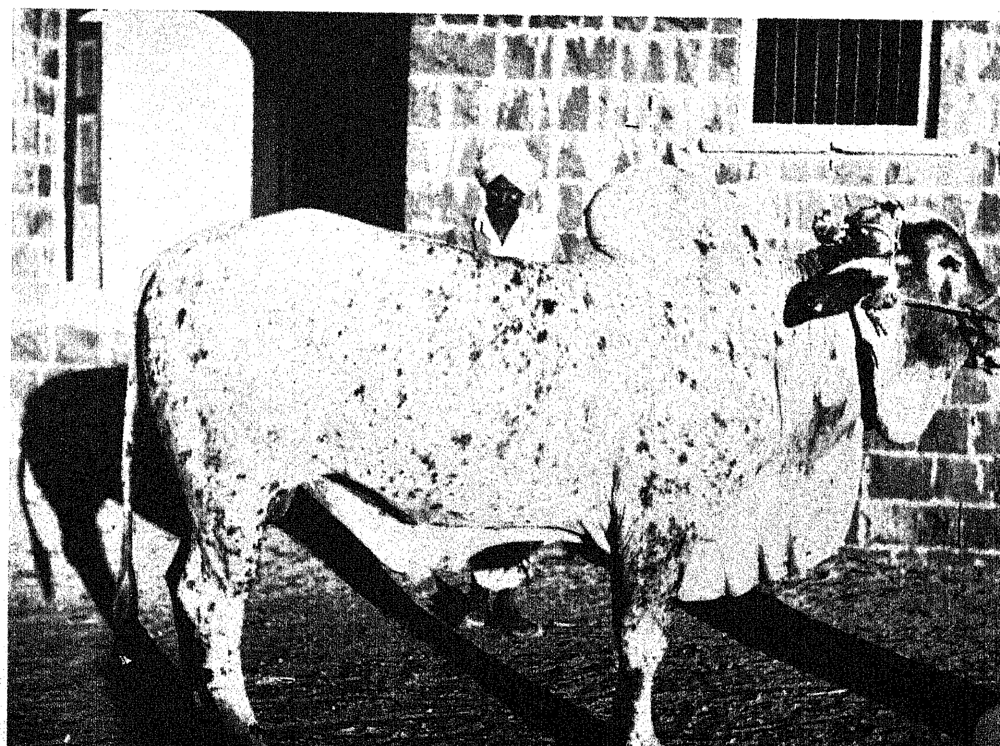
The Dominions have benefited by the assistance of the Imperial Council of Agricultural Research due to which a Disease Investigation Officer has been appointed. During last year, investigations on the circling disease of sheep, liver fluke infestation, surra in cattle and horses and various other problems such as tuberculosis in buffaloes and cattle and other parasitic infestations were continued. Very valuable work is being done. A temporary virus depot for the production of the tissue vaccine required in the prevention of rinderpest has been opened at the Veterinary Directorate. Special attention is being given to obscure or hitherto neglected diseases which are responsible for the loss of efficiency of agricultural cattle. Inquiry into deficiency diseases and malnutrition and parasitic infestations is in progress.

There used to be 12 stationary veterinary hospitals under the charge of qualified veterinary surgeons in the city of Hyderabad and the districts. Four stationary veterinary hospitals were established last year, in Medak, Nalgonda, Parbhani and Asifabad districts,



Deoni cow

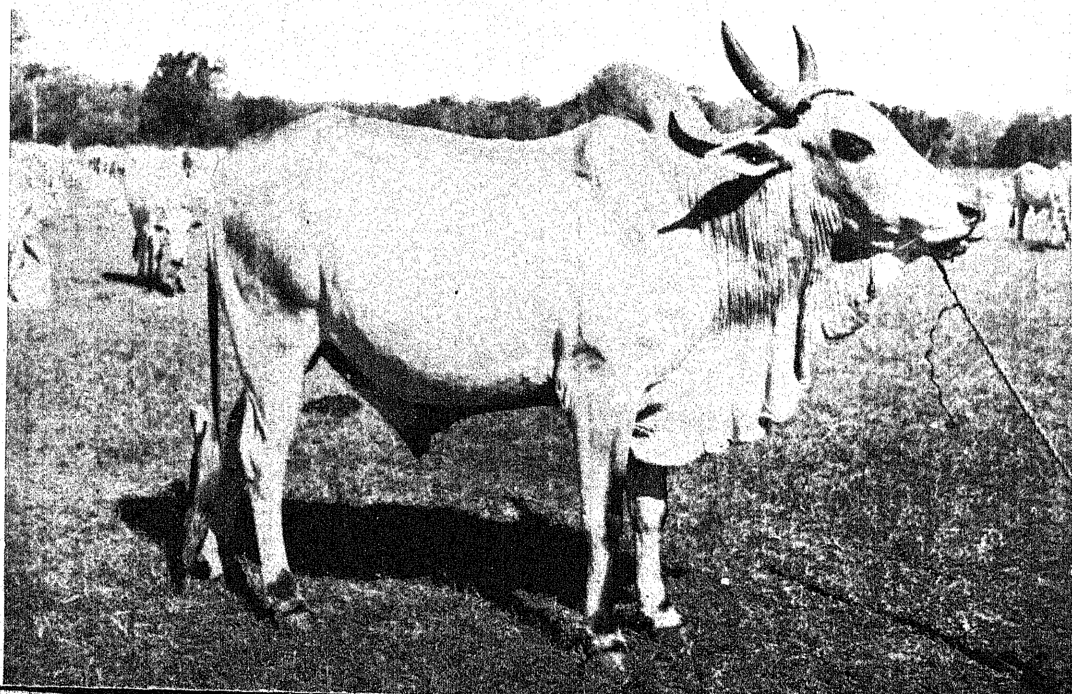
PLATE 118 |



Deoni Dongri bull

Krishna valley bull

[PLATE 119



Malvi bull

thus providing one stationary hospital and two dispensaries in the city of Hyderabad. The Department has five gazetted executive officers and 130 subordinate executive staff most of whom are itinerant officials working their way right into the villages, taking measures for prevention and treatment of diseases and spreading the knowledge of modern methods of livestock management. Rinderpest, which is the greatest scourge of cattle, can be said to have been brought under check. Cattle routes have been mapped out, and in a large number of villages lying on these routes cattle have been inoculated against rinderpest, and the spread of the disease prevented. Surra in cattle, which has received great attention recently, has been successfully treated in the Dominions. Parasitic infestation of cattle was specially studied in the Nizamsagar area and active measures adopted for the control of liver fluke. This gives great hopes for the extension of operations for effective control of the disease. Other infectious diseases also receive proper attention.

Animal welfare

About 23 shows are held in the Dominions. The most important of these are the Udgir Cattle Show for the Deoni breed, the Malegaon Horse and Cattle Show, and the Srirangapur Cattle Show for the Krishna Valley breed in Mahbubnagar district. Valuable prizes such as silver bangles and medals and cash prizes are awarded at these shows. The staff of the Veterinary Department regularly take part in all improvement work and castrate scrub bulls, treat cattle against diseases and give demonstrations regarding methods of care and treatment of livestock with magic lanterns, cinema pictures, specimens and posters. Bulletins on veterinary subjects are also distibuted free. In addition to their duties, the officers of the Veterinary Department take part in S. P. C. A. work. They inspect all animals used for public conveyances whenever their help is solicited, thus making themselves useful in all that concerns the welfare of livestock.

The total number of societies of all types in the Dominions increased last year from 3,638 to 3,958. They consisted of the Dominion Bank, the Cooperative Union, 40 central banks, 3,188 village thrift and credit societies, 701 non-agricultural societies and 27 societies of the British administered areas. There was thus a net increase of 320 societies consisting of 279 village thrift and credit societies and 41 non-agricultural societies.

The total membership of societies increased by 16,464 from 137,948 to 154,412. The largest increase of 9,309 was in the membership of non-agricultural societies, while the membership of agricultural societies increased by 7,155.

The owned capital of the movement increased from Rs 11,16,71,633 to Rs 1,20,87,681. There was thus a satisfactory increase of Rs 4,16,048. The share capital was Rs 63,45,273, while the various reserves stood at Rs 57,42,408. The proportion of the owned to the working capital was 48 per cent.

Use of waste products

A well-attended agricultural demonstration was held recently at the Rudrur Experimental Farm, Nizamabad district. The farm has an area of 65 acres of which 50 are actually under cultivation, and also a sugarcane research station, where varietal, manurial and cultural experiments on various crops are conducted. Preliminary agronomic and botanical studies relating to varieties of cane are in progress to find out the characteristics possessed by the desired types.

Cultivators took a special interest in the demonstration of the working of improved implements such as soil-turning ploughs, harrows and seed drills. They were shown how compost from farm waste can be prepared; also flue-curing of tobacco for cigarettes. Perhaps the most interesting feature was the demonstration of the utilization of waste products for making domestic articles, such as screens (*chiks*), baskets, etc. from sugarcane flower-stalks.

An exhibition of agricultural produce, fruits and vegetables was also held, and cultivators were awarded prizes for their exhibits in the shape of implements, manures and seeds.

An agricultural play, *Premi Kisan*, was

produced in Telugu by the labourers of the Rudrur Farm.

The Tenancy Committee

The Tenancy Committee, which was appointed by Government in 1937 to investigate the condition, rights and obligations of agricultural tenants and to suggest necessary legislation for their relief and protection, has submitted its report. The findings of the Committee are based on investigations carried out in 48 villages situated in various parts of the Dominions.

The Committee has also drafted a Bill in the light of its findings for the consideration of the State Legislative Council. The Bill has been referred to a Select Committee. The Bill is designed to afford due protection to agricultural tenants and remove their present disabilities. The Committee suggests that the proposed legislation should be made applicable to the lands which are under the direct management of Government and the revenue from which goes to the state exchequer and the other lands.

The main provisions of the Bill are that all *asamishikmis* (sub-tenants) who have been cultivating land for a period of six years or more will be protected *asamishikmis* who will not be liable to eviction so long as they continue to pay a reasonable rent punctually and do not cause any permanent injury to the land and so long as the land is not required by the landlord for personal cultivation or for a non-agricultural purpose. The rights of the landlord also have been sufficiently safeguarded in the Bill. Provision has also been made for compulsory proportionate suspension and remission of rent in bad seasons when land revenue is wholly or partly suspended or remitted.

Another important provision in the Bill is to the effect that no lease of land made after the commencement of the Act shall be for a period of less than ten years. The Bill empowers Government to fix the maximum rent in particular areas by notification. This is specially meant for the benefit of backward tribes and aborigines. Landlords will be bound to give receipts for rent received.

Broad basis of rural uplift

The policy laid down by the Government regarding rural reconstruction is that the nation-building departments should aim during the initial stage at the intensive development of one or two villages in each taluka. This is a safe policy as the rural uplift work will develop by degrees and will largely depend on the successful steps taken against poverty in the rural areas.

The annual report on the working of the movement for the year ending 6 June 1940 is just out. It shows some solid work done in connection with better business, better farming and better living in 120 selected villages of the state. The Cooperative Department concentrated on popularizing the membership of existing societies with the result that there was an increase of about 30 per cent with a majority of landowning members. A good many societies changed the basis of subscription from a uniform rate per family to a levy of a few pies per rupee on land revenue paid by agricultural families. This change was generally welcome. Merchants and artisans, however, paid a fixed annual contribution per family. Village committees enlist labourers as members on condition that they contribute a day's labour per family every year to the general improvement of the village such as filling up pits, digging drains, cleaning lanes, etc.

The cooperative thrift and credit societies and the grain banks in the selected villages are progressing satisfactorily. These may ultimately develop into rural banks with their owned resources for the profitable supply of agricultural requirements and the disposal of agricultural produce of the surrounding villages. The number of grain banks increased during the year from 50 to 79 and their membership from 1,858 to 3,260.

Popularity of fruit trees

The Agricultural Department is trying to educate the cultivators by establishing aided farms and demonstration plots and by the distribution of improved seeds and manures. The fruit trees newly planted exceeded 22,000. The number of manure pits dug during the

year was 276, which raised the total number to 2,875 in the selected villages. Veterinary officers castrated 1,222 bulls and vaccinated 4,299 cattle during the year. Income earned through subsidiary agricultural industries was roughly estimated at Rs 39,000 by the sale of ghee and Rs 8,000 by the sale of poultry and eggs.

In the selected villages local committees were given free scope in spending the money raised by subscription. The Government Departments of Education, Health and Local Fund assisted the societies with money and advice. There were 6,067 children vaccinated and 6,206 persons inoculated against plague by the Medical Department. The rural reconstruction societies purchased medicines worth Rs 1,000 and they were given out to 6,651 persons. The relief thus afforded is appreciated by villagers. Educational facilities were provided in nearly all villages at a cost of Rs 72,231 on boys' schools. The number of boys' schools was 101 with 6,938 boys and 207 teachers. The amount spent on girls' education was Rs 7,803 on 25 schools with 987 girls and 35 teachers.

Rural uplift rally

During October last, the Rural Development Centre at Patancheru was transferred from the Agricultural Department to the Central Cooperative Union.

The Centre organized a rural uplift rally from 24 to 26 March 1941. It started with a procession. The programme consisted of a hygienic village dwellings competition, village poultry show, agricultural produce, cattle show, baby competition and sports. Demonstrations of weaving, dyeing and printing cloth, lantern lectures, radio reception, dramatic and musical entertainment were also arranged. A large number of villagers from the neighbouring villages attended the function which was extremely entertaining and instructive.

The Central Cooperative Union at Hyderabad has started a monthly magazine named *Gaon Sudhar* (village uplift) from March 1941. It aims at rural reconstruction and deals with agriculture, cooperation and allied subjects. It is being issued in the four local languages, Urdu, Telugu, Marathi and Kanarese.

Talks on the radio

A beginning was made by the Hyderabad Wireless Department with programmes of rural interest in certain selected villages in Aurangabad district on the opening of the Aurangabad broadcasting station by the Rt. Hon. Sir Akbar Hydari, on 4 April 1941. The station is regional in character and is designed to cater for local needs. In the beginning one hour daily will be earmarked for rural broadcasts. Over two dozen sets have been purchased by the Government for the benefit of people living round about Aurangabad. The rural broadcasts will be made informative, instructive and interesting by inclusion of Urdu and Marathi talks, news, folk-songs and popular music. It is understood that after a little more experience of broadcasting to villages and of programme-planning for the purpose, the system will be extended to cover a larger number of villages not only through the Aurangabad transmitter but through the Hyderabad station as well.

ASSAM

By S. Chakrabarti, B.A. (Hons.)
Assistant, Office of the Director of Agriculture, Assam

SALE of mixed produce of varying and uncertain quality is a common practice throughout India, and Assam is no exception to this rule. This practice makes price comparison difficult and causes unnecessary expenditure in the handling and transport of worthless goods from the producing centres to the market. It also brings down the general level of prices on account of higher labour cost in cleaning and sorting the commodities at the consuming centres. For eliminating waste and for providing a common basis

for trading on standard quality with a view to promoting the interests of both the producers and consumers, it is necessary to grade all agricultural produce, and with this object the Agricultural Produce (Grading and Marking) Act, 1937, was passed. The Department of Agriculture has recently started the grading of oranges and eggs in Assam with the help of authorized graders under this Act. Both eggs and oranges are graded by a machine set to sort out automatically eggs and fruits according to the different weights and sizes respectively, as specified under the Act.

Oranges are graded at Gauhati with the help of the following authorized graders:

Mr K. C. Thakuria, The United Fruit Co. Ltd., Mr A. K. Bhattacharyya, Mr S. C. Bhattacharyya, Mr N. L. Mukherjee, Sardar N. Singh, and Mrs J. Gatpoh.

These graded oranges are being transported to Calcutta where they are sold through the fruit selling agency set up by the Department of Agriculture, Assam. Through this agency 223,283 graded oranges, valued (net) at Rs 3,500, have been disposed of during the months of January, February and March 1941. In addition, 1,348,457 ungraded oranges, valued (net) at Rs 11,750, have also been sold in Calcutta during these three months through the same agency.

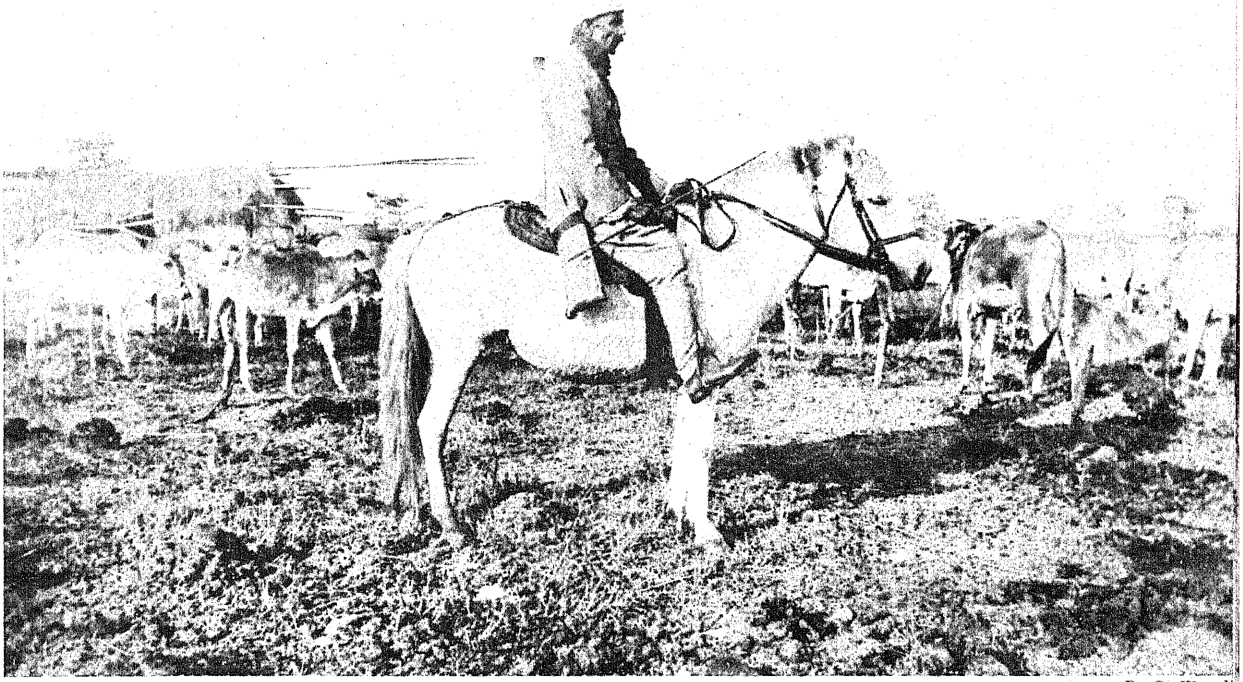
Assam pineapples are also being sold in Calcutta through the departmental fruit selling agency, but the pineapples are not being graded at present. During the last season 19,503 pineapples, valued (net) at Rs 4,050, have been sold in this manner.

Egg grading is being done at Shillong and Gauhati with the help of two authorized graders—Ka Piti in Shillong and Mr K. C. Thakuria at Gauhati, who locally sold 12,657 graded eggs, valued (net) at Rs 350, during the months of January, February and March 1941.

By taking up this work the Department is endeavouring to show to the producers and the trade the possibilities of obtaining a premium on graded as compared to ungraded produce. The work done so far has shown that there are great potentialities in grading. However, it requires time for the graded produce to influence the market. Unless buyers in general become aware of the existence of the graded produce, an appreciable premium for the higher quality cannot be expected. The Department is, therefore, giving wide publicity to this work to overcome the handicap. It has also been noticed that the persons concerned with grading do not often realize that the work is in their own interest. In spite of these handicaps, the success achieved so far indicates that there is a demand for graded fruits and eggs and it may be expected that the Department's efforts will be rewarded with success.

Grazing reserves for cattle improvement

Assam's grazing reserves (other than village grazing grounds) cover an area of about 376,900 acres. Nepali graziers, financed by *mahajans*, rear cattle and buffaloes in these reserves where the total number of cattle and buffaloes is about 80,000 and 70,000 respectively. With proper supervision these reserves can be developed into important centres for breeding cattle and buffaloes of superior breeds and for the production of milk and milk products. Already, thousands of cheap and hardy bullocks are sold by the Nepali graziers every year from these areas and some of the reserves, located near towns, provide a regular supply of milk and ghee to the townspeople. The stock of the grazing reserve cattle is, however, deteriorating due to indiscriminate breeding, and the Department of Agriculture has, therefore, taken the cattle in some of the reserves under its control. When the Department wants to bring a reserve under control, it approaches the Deputy Commissioner concerned who 'notifies' the reserve as a 'cattle-breeding reserve'. When the reserve is so notified a special set of rules comes into force and the Department of Agriculture undertakes the castration of weedy bulls and supplies improved breeding bulls for grading up the graziers' cattle, thus ensuring that breeding is done only by Government bulls and selected local bulls. For encouraging the castration of weedy bulls an annual grazing fee of Re 1-2 is levied on every head of uncastrated weedy bull, whereas a grazing fee of only 6 annas is imposed on every other head of cattle, and the selected



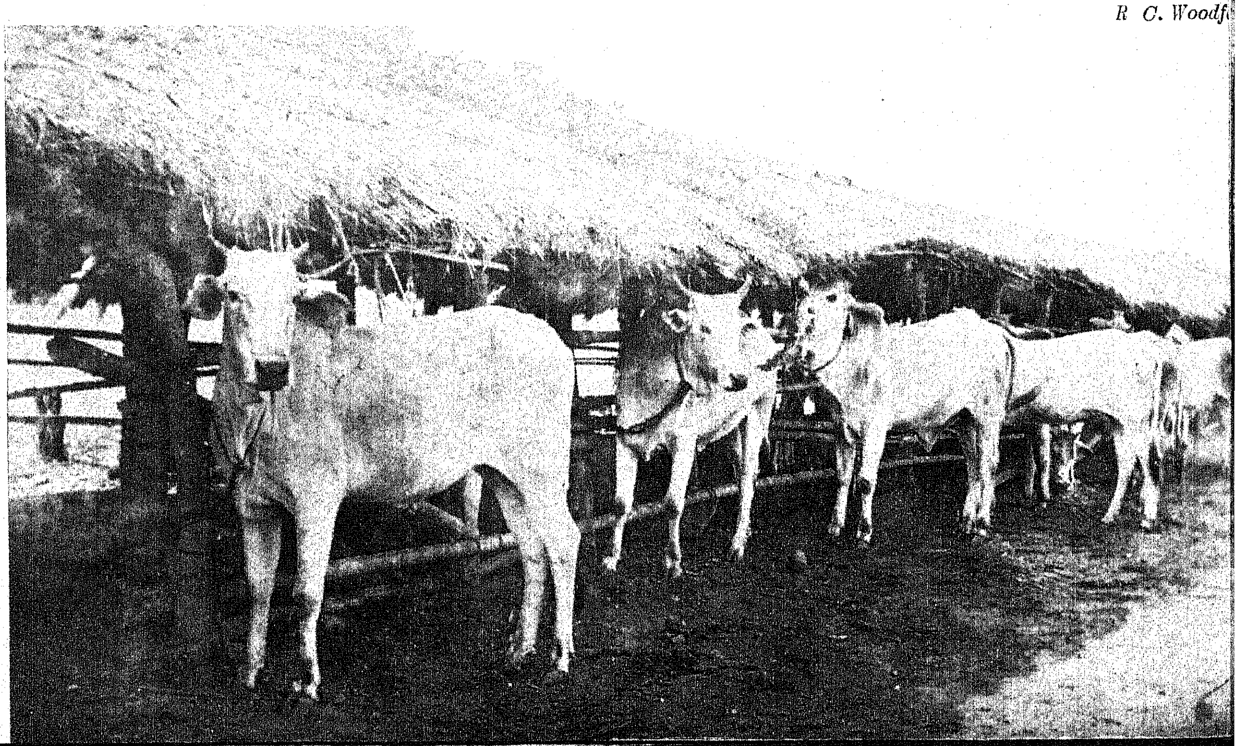
R. C. Woodf

A grazier *mahajan* and one of his herds

PLATE 120]

Harianas—two years old—at Aie River Forest Reserve. They were purchased as calves in Calcutta and reared under grazing conditions.

R C. Woodf



breeding bulls are allowed to graze free. This differential levy of grazing fee has induced the graziers to maintain good breeding bulls and to castrate surplus young bulls not fit for breeding. At present, cattle in the following grazing reserves are under the control of the Department of Agriculture:

Aie River Forest Reserve in Goalpara, Barapetta Professional Grazing Reserve in Kamrup, Subankhata-Pakhamara Grazing Reserve in Kamrup, Lanka Professional Grazing Reserve in Nowgong, and Burachupari Professional Grazing Reserve in Darrang.

These five reserves cover an approximate area of 40,000 acres and contain about 12,500 cattle, excluding young stock under the age of two years. Up to date Government breeding bulls have served 4,640 cows in these reserves and 1,467 calves have been recorded as sired by them. All services and births could not, however, be recorded due to the wild condition of the reserves, but it can safely be assumed that the actual number of services and births must have been at least 50 per cent more than the number recorded.

Motion pictures for propaganda

Lantern lectures have for a very long time been an important means of popularizing improvements in agriculture and animal husbandry in the villages of Assam. The still slide has, however, lost much of its appeal in recent years due to the introduction of motion pictures for entertainment. Propaganda defeats its object if it fails to interest people. The Department of Agriculture has, therefore, purchased a motion picture unit, consisting of a Kodak projector and a number of films on agriculture and animal husbandry for carrying on the good work that lantern slides have been doing so long. A motion picture camera has also been purchased for taking pictures with a view to making instructive films from them.

Mass literacy

The mass literacy campaign in Assam has made considerable progress during the first term, at the end of which 19,000 examinees sat for the first literacy test, of whom 15,000 came out successful. Government has given freely out of its funds for the success of this campaign. It has spent Rs. 12,000 for the preparation and publication of primers and reading sheets and for printing posters, pamphlets, charts, etc. Another sum of Rs. 10,000 has been spent for meeting contingent expenditure at the mass literacy centres, where the Government is supplying such articles as lights, slates, pencils, etc. Government has appointed 19 assistant sub-inspectors of schools and three assistant mass literacy officers, in addition to the Mass Literacy Officer, for assisting the subdivisional staff in the supervision of these centres. The staff will be further strengthened.

The campaign was started in September last and the tremendous enthusiasm which the public exhibited then still continues. Steps are now being taken to ensure attendance at the post-literacy study circles, which are being started at every mass literacy centre. For the post-literacy study circles interesting books with a limited vocabulary are being prepared and will be supplied free to the circles. A fortnightly magazine, *Gana Siksha*, is being published in Assamese and Bengali. This magazine also will be supplied free to the study circles. A considerable sum of money has been spent for the purchase of books, boxes and circulating libraries for the study circles.

The first test of literacy was held in December-January last, but as harvesting was then in progress 13,000 out of 32,000 pupils on the rolls could not take it. Supplementary tests will be held for those who could not sit at this test. It has now been decided to hold the test at such a time as would suit the convenience of the cultivators.

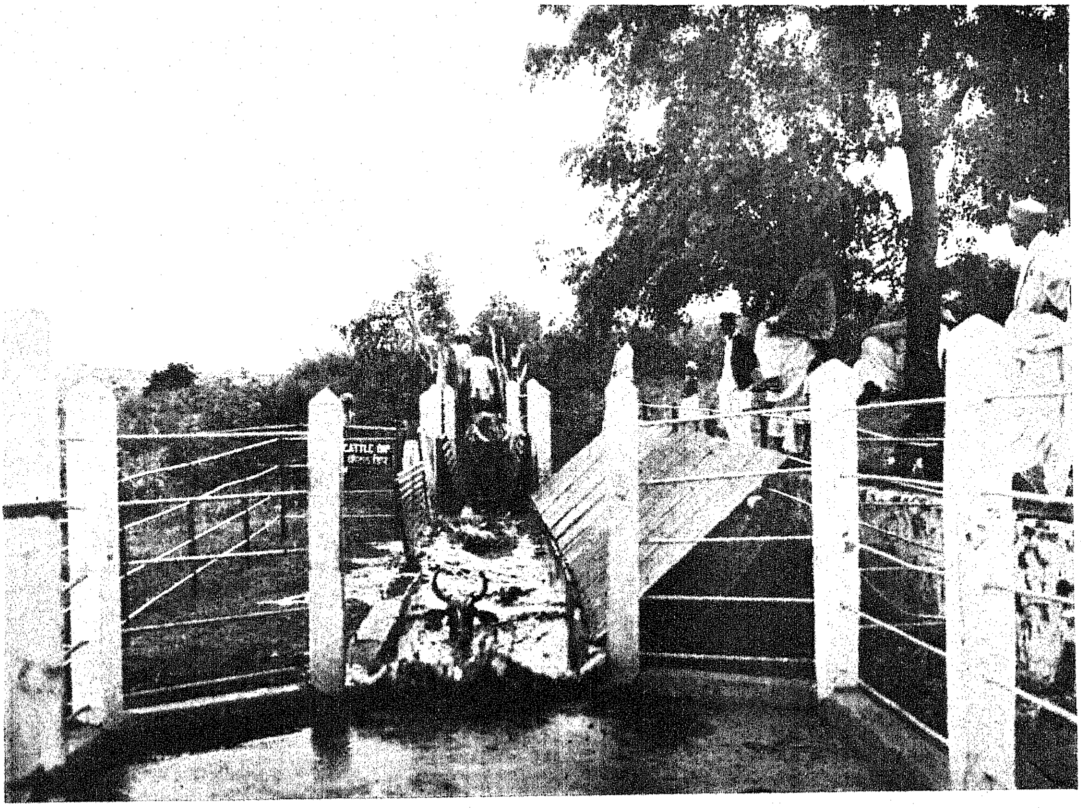
It is now proposed to open about 200 mass literacy centres in each subdivision. At the rate of 15 pupils passing out from each centre every term, each subdivision will turn out about 3,000 literates per term or about 9,000 per year. The outturn for the whole province per year may thus come to 1,75,000. To this may be added the number taught at aided centres run by tea estates, factories, students' organizations, educational societies and women's welfare societies, which will continue to get Government aid.

CONTROL OF TICKS IN BOMBAY

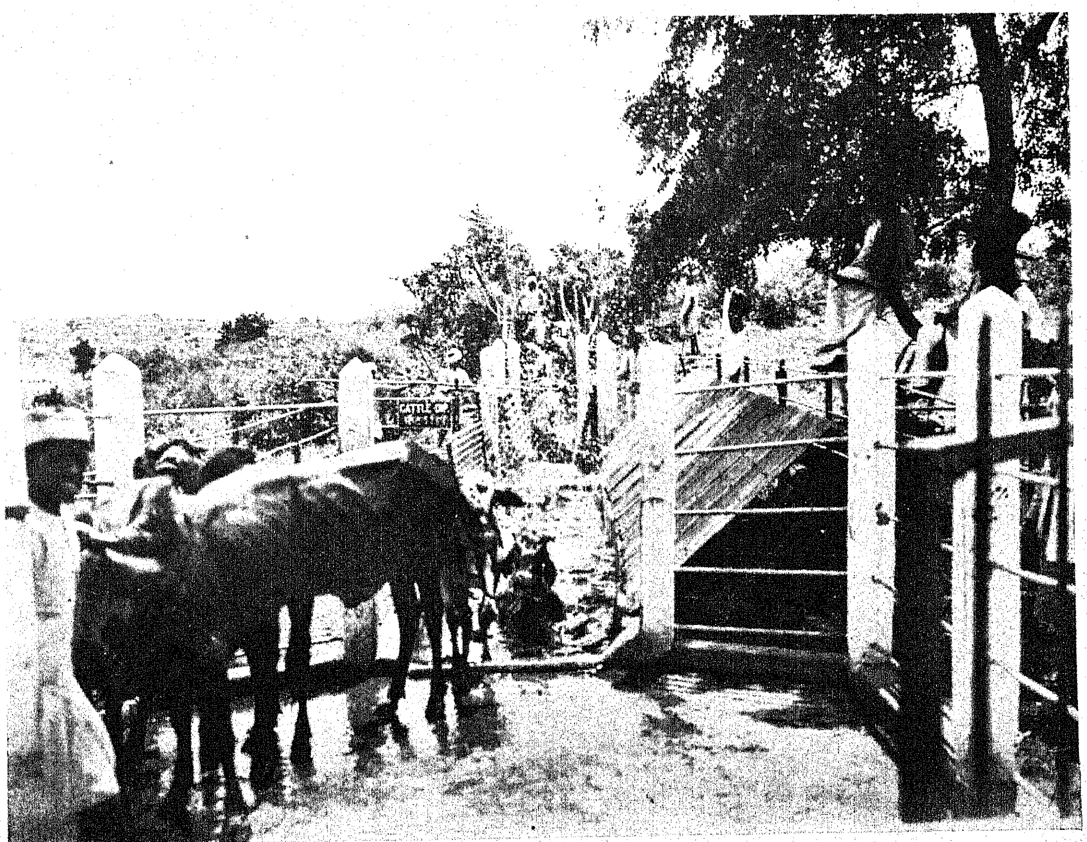
By R. N. Naik, G.B.V.C.
Veterinary Investigation Officer, Bombay Province

TICK infestation is a serious menace to cattle-breeding, dairying and the hide and leather industries in India and therefore their control is one of the major problems requiring solution. The Civil Veterinary Department, Bombay, realizing the economic importance of this pest, has introduced as a preventive measure cattle dipping and spraying operations in a few villages in different divisions of this province, viz. Turkewadi, Benkatti, Devgiri, Kumbhari, Pimple, Nandurbar, Halkar, Khandivli, Betegaon and Dombivli. The cattle population numbers about 150 to 600 at each of these villages except at Devgiri and Kumbhari where it exceeds 1,000. The total number of cattle and buffaloes dipped and sprayed with arsenic solution in the first six villages mentioned above was 3,332 during the quarter ending September 1940. It has been observed that animals dipped regularly harboured few ticks, grew faster and showed much better body condition and a shiny coat and fetched higher prices in the market than undipped animals. This shows that regular dipping of cattle increases their strength and stamina, is profitable to cattle owners in the long run and results in more valuable hides since they are free from tick bite punctures.

On 26 November 1940, one more cattle-dipping tank was opened by the Director of Veterinary Services, Bombay, at Tandulwadi in Satara district. The dipping tank was constructed from funds subscribed by the villagers of Tandulwadi themselves and a grant from village uplift funds. The construction work was carried out by the District Local Board, Satara. The recurring expenses of this and some other tanks and the spraying machines are paid from funds sanctioned by the Imperial Council of Agricultural Research, New Delhi, under the scheme for the control of ticks.



Cattle being dipped at the cattle dipping tank, Pimple



The Month's Clip

UTILIZING SOYBEANS

RECENT increases in the soybean acreage have resulted from the large number of small patches grown by individual farmers for home consumption. In most cases the crop is grown to maturity with the intention of feeding the beans to livestock.

Soybean seed normally contains from 30 to 40 per cent of protein and compares favourably in feeding value with other concentrated feeds, such as linseed and cotton seed oil meal, states the Division of Forage Plants, Dominion Experimental Farms Service. The growing of soybean seed for feed will produce, at a moderate cost, the high protein concentrate necessary for stock feeding and milk production. The amount of soybeans included in the grain ration of dairy cows is usually around 15 per cent, but this will vary somewhat according to the kind of hay that is being fed. The beans should be mixed with the other grain previous to grinding, as the high oil content of soybeans makes them difficult to grind alone.

Soybean hay is about equal to alfalfa hay in feeding value, according to both feeding tests and chemical analysis. It is customary to cut the hay at the time when the pods are about half filled out.

Soybean straw from threshed soybeans, while not high in feeding value, has been used satisfactorily as a roughage for wintering dry cows and beef cattle. It is also good roughage for sheep.

Soybeans and corn may be grown in together for ensilage or the two may be grown separately and mixed in the proportion of 2 or 3 parts corn to 1 part soybeans at the time of silo filling. In selecting a variety for ensilage use, care should be exercised in choosing one that will produce good growth and reach the desired stage of maturity at the normal harvest time.—*Press Note, Dominion Department of Agriculture, Canada.*

BREEDING EWES

IT is the shepherd's dream to have a large crop of vigorous lambs every spring. In order to help make this dream come true, great care must be taken in the selection of the breeding ewe. Points such as age, health, conformation, soundness of udder, wool, and breeding ability should all be considered, states P. E. Sylvestre, Animal Husbandry Division, Dominion Experimental Farms Service.

First, discard the old ewes. Animals seven years and older should not be kept unless exceptionally sound and healthy. Ewe lambs can be bred, but they must be well developed.

A flock of well-grown, healthy individuals will produce growthy lambs. Small, unthrifty ewes are likely to produce slow-maturing and undersized lambs. A clear skin, bright eyes and a lustrous fleece containing plenty of yolk indicate good health.

Since emphasis is being placed on mutton type, fairly low-set individuals with broad, deep, capacious bodies should have the preference. Avoid especially the upstanding, narrow-chested individuals. They are usually disappointments as reproducers.

In culling ewes, the udder should always be examined and no animal kept that is abnormal in any way. Lumps in the udder or teats injured by careless shearing usually mean future difficulties and dissatisfaction.

Although lambs still form the greater part of the revenue from sheep, the fleece, especially in wartime, should be given a good deal of attention. Not only is it at present a good source of revenue, but it is also a protection for the sheep against inclement weather. The flock owner should therefore choose ewes with a compact, uniform fleece of good length. The wool should extend well under the body as this influences the amount produced. Breed characteristics should be taken into consideration whenever purebred sheep are raised.

No matter how careful the selection, the good appearance of a ewe is not always

sufficient indication of her value as a breeder. She must also be a high producer, that is, produce many pounds of desirable lamb and of good wool each year. Hence, some record should be kept which would show the most productive ones. A record showing the number of the ewe, the weight of the fleece, the number of lambs dropped and raised, and the weight of the lambs at weaning time is quite simple to keep and very valuable. It enables the breeder to cull more effectively; it tells him which ewes are the most prolific and which are the best milkers. Last but not least, it facilitates the selection of the ewe lambs which are to be used in the future and makes possible the improvement of the prolificacy and the lamb-raising abilities of the flock. With such a system and by taking into consideration the general conformation of the animals the selection of breeding ewes becomes an easy and interesting task.—*Press Note, Dominion Department of Agriculture, Canada.*

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CARE OF COLTS

THE selection of good breeding stock is of importance to successful breeding, but the proper care and feeding of colts is equally necessary, says C. F. Bailey, Superintendent, Dominion Experimental Farm, Fredericton, N.B. Colts that are under-fed and improperly cared for as yearlings are undersized and poorly developed when they reach maturity. On the other hand, over-feeding involves unnecessary expense and may create a tendency for animals to become unsound.

At the Fredericton Experimental Station roomy box stalls are provided for colts. Two colts of the same age run together where space will permit. The colts are fed off the floor—this practice tends to strengthen the knees and develop the leg and neck muscles of growing colts.

Colts are fed a daily ration composed of good, clean, mixed hay and crushed or rolled oats and bran (4 parts oats to 1 of bran). The amount of grain fed per day varies with the size and condition of the colt, but as a general rule, not more than one pound of grain is fed for each 100 lb. live weight. Turnips are fed each day, but carrots are preferred if available. Iodized salt is before the colts at all times and water is supplied at regular intervals throughout the day.

The importance of exercise is also recognized; colts are provided with a large exercise yard (1 to 2 acres) where they are turned out for exercise each day except during bad weather. This exercise yard provides protection against winds. The average barn yard is too small for exercising colts.

During the summer months a good pasture is provided for colts. This insures a generous supply of nutritious grass, running water and shade trees to protect the colts against flies and the hot sun. Salt is available at all times. When the colts are provided with good pasture, the feeding of grain is not considered necessary.

The colt's feet also receive careful attention. As a rule, the feet are trimmed at intervals of six weeks; the toes are kept short, and the heels quite low—the bottom of the feet is trimmed level. This applies to the outer rim of the feet. The proper care of the feet has a marked influence on the development of the colt, and particularly its gait. Colts with crooked legs are greatly improved by this practice.—*Press Note, Dominion Department of Agriculture, Canada.*

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SOURCES OF TOBACCO DISEASES

DISEASES rank as one of the major problems in the production of tobacco. To assist the growers in this connection the Dominion Experimental Farms Service and the Laboratory of Plant Pathology of the Science Service, Harrow, are carrying on extensive research work, state R. J. Haslam, Assistant Superintendent of the Experimental Station, and L. W. Koch, Plant Pathologist in Charge of the Laboratory.

In the case of those diseases where the causal organism is definitely known, source of an outbreak on a grower's farm can often be traced to some improper practice. In this connection the seed, plantbed and crop residue have been found to be potential sources of infection for the more common diseases. Few diseases are borne by the seed kernel,

but chaff particles or foreign material mixed with the seed may be the cause of carrying disease organisms such as leaf spots and mosaic into the plantbed. It is advisable, therefore, to sow seed of good germination that has been properly cleaned.

Frequently during the late summer and autumn, weeds are found in and around tobacco beds. These are often the source of certain tobacco diseases because certain weeds are subject to the same diseases as the tobacco plant, and in the presence of either appropriate weeds or tobacco plants disease organisms tend to accumulate. As a precautionary measure, therefore, plantbeds should be cleaned up as soon as transplanting is completed. Weeds that appear later in the season should be destroyed together with trash that tends to collect in and around the beds. Cleaning-up practices are most effective if carried out in advance of steaming the soil, because disease organisms that enter the soil after steaming meet with less competition from harmless organisms and, therefore, accumulate more rapidly. Unless these precautionary measures are taken, the money expended on steaming may be lost.

Tobacco beds situated adjacent to the curing barns are likely to be contaminated from tobacco residue which sometimes is allowed to accumulate inside the barn. When the tobacco is removed from the barn for stripping, any residue remaining should be cleaned up. If diseases such as mosaic and leaf spot have been a menace in previous years, it would be advisable to shift the location of the tobacco beds or disinfect the inside of the barn and any woodwork around the beds with a 2 per cent solution of formaldehyde. This will remove the possibility of the beds becoming contaminated.

Tobacco stalks, if not properly handled, may be a source of infection for mosaic and leaf diseases. In the case of flue-cured tobacco the stalk cutter and a cover crop of rye are recommended rather than leaving the stalks dry and uncut during the winter months. Stalks from air-cured tobacco should not be spread on fields where tobacco will be grown the following year.

Finally, the tobacco grower should be careful not to throw diseased tobacco materials into manure piles later to be applied to prospective tobacco ground, since leaf spots and mosaic may be spread in this manner.—*Press Note, Dominion Department of Agriculture, Canada.*

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FEEDING OF DAIRY COWS

SUCCESSFUL dairy farmers recently have been giving more attention to the economical feeding of their cows and many are wondering what they can do to cut down feed costs. The importance of this phase of dairy production may be realized when it is remembered that the feed cost is approximately 50 per cent of the total cost of milk production.

The feeding practices which have been found satisfactory at the Central Experimental Farm, Ottawa, states C. D. MacKenzie, Division of Animal Husbandry, may be of assistance to many farmers. Particular attention is paid to the amount and quality of the hay that is grown and fed. A special effort is always made to provide sufficient legume roughages such as alfalfa and red clover, and thus a large part of the protein needed is supplied in this portion of the ration. The hay fed is of good quality, early cut and well-cured, since this type of hay is higher in protein than late cut poorly-cured hay. When necessary, the making of legume silage may be considered, this in addition to the usual corn silage provided.

The protein content of the meal mixture used is adjusted to the kind and quality of the roughage on hand. It is kept in mind that when large amounts of protein-rich concentrates are purchased they involve a considerable cash outlay. Therefore, as large a part as possible of the protein in the ration is grown on the farm, and thus a marked saving is made. When feeding alfalfa or clover hay the meal mixture contains approximately 16 per cent protein, and an example of such a mixture is ground oats 300 lb., ground barley 200 lb., corn gluten feed 100 lb., bran 100 lb. and linseed oilmeal or ground soybeans 100 lb. Note that this mixture is made up of 500 lb. of home-grown grains, 200 lb. of mill feeds and 100 lb.

of high protein concentrates. However, if mixed hay only is available, the mixture is raised to about 20 per cent protein, and it might be made up of ground oats 300 lb., ground barley 200 lb., bran 200 lb., soybean oilmeal 100 lb., and linseed oilmeal or ground soybeans 100 lb. As a general rule, 1 lb. of meal mixture is fed daily for every 4 lb. of milk produced. This amount depends, however, on a number of factors such as the butterfat content of the milk, the total amount of milk produced by each cow, and her condition and stage of lactation.

All cows are provided with sufficient salt, which may be included in the meal at the rate of 2 per cent or placed in front of the cows at all times. If the cows are milking heavily or the quality of the hay is poor it is advisable to supply them with feeding bone-meal in like manner and amount to that of salt.

Extra attention, too, is given to pasture management problems, and to the advisability of supplementary pasture crops, so that complete rations for both summer and winter feeding may be produced on the farm as far as possible.—*Press Note, Dominion Department of Agriculture, Canada.*

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CREEP FEED THE LITTER

RESULTS at the Dominion Experimental Station, Lacombe, Alberta, where hog raising is featured, have proved that grain fed to suckling pigs is beneficial. The extra feed produces pigs that are up to 5 lb. heavier at weaning than are pigs allowed no additional feed. This supplementary feed results in less drain on the system of the sow, greater uniformity within the litter and lessened mortality, says H. E. Wilson, on the Staff at the Lacombe Station.

When about three weeks of age the young pigs will have learned to eat. At this time they should be fed easily digested feeds carrying a very low percentage of fibrous matter. Oat hulls or coarse feed of any kind is detrimental to small pigs. Unless the hulls have been removed, ordinary oat chop contains too much fibre to be fed to very young pigs. They cannot digest the fibre in oat hulls. The hulls may be removed from oat chop either by sifting the chop through an ordinary screen-door wire screen, or through the use of a fanning mill by adjusting the sieves and wind. The portion of the hull that remains is the very fine particles which would not be seriously detrimental to the young pigs. Shorts, because of its low fibre content, is also a feed of value in the ration of the young pig. Shorts and sifted or hulless oat chop are very palatable and nourishing feeds for young pigs.

A ration which has been used with good success in the separate feeding of suckling pigs at Lacombe Station consists of equal parts of sifted or hulless oat chop and shorts, supplemented with sweet skimmilk or fresh buttermilk. If milk is not available 5 lb. of tankage should be thoroughly mixed in each 100 lb. of the meal ration fed.

The separate feeding is accomplished by means of a 'creep' or barrier which may be erected in a corner of the pen, leaving an opening of such size that the pigs can run in and out while the sow is excluded. If the sow's pen is not large enough to permit the erection of a creep, some arrangement should be made whereby the little pigs can be allowed to run out into the alleyway of the pig barn so that they may be fed the meal mixture in a small trough separately from the sow. The milk should be fed in a separate trough in the creep. Care should be taken to see that the feeding utensils and troughs are kept sanitary and clean for suckling pigs.

When suckling pigs are allowed access to extra feed before weaning, in a creep or alleyway separate from the mother sow, the usual shock or set-back at this critical time is reduced to a minimum. This is good preparation for the weaning period.

Creep feeding will induce nursing pigs to feed early. This is a very important consideration in connection with the control of anaemia, for as soon as the little pigs begin to eat food from the trough, danger of anaemia is passed.—*Press Note, Dominion Department of Agriculture, Canada.*

New Books and Reviews

Indian Sugar Manual

(The Sugar Technologists' Association of India, Cawnpore, 1940 : pp. 355.)

THE important place which the sugar industry has come to occupy in the industrial system of India provides ample justification for this welcome addition to the literature devoted to that industry. The keynote of this book is its objectivity. As the author himself remarks, the object of the work is to present facts, and not to supply ready-made opinions. It describes, with full statistical detail, the sugar economy of India in relation to its natural background, namely the world's sugar economy. The opening chapters are taken up exclusively by the latter. Besides giving statistics of production, consumption, imports, exports, prices, tariff and so on, they furnish an account of the various measures adopted in the last decade to stabilize the world sugar markets. The markets were in the worst depths of despondency in the black years of 1931 and 1932. An international conference met in Brussels in 1931 and reached an agreement, which, however, proved infructuous. In 1937, therefore, another and more representative conference met in London, and produced an agreement, commonly called the International Sugar Agreement, which worked with some success till the close of 1939, when its provisions became practically inoperative owing to war. The manual gives a detailed narrative of the history of these agreements, their aims and objects and the main implications of their provisions. Passing on from stabilization of world prices to stabilization of internal prices in particular countries, the manual has a chapter devoted to describing the various national policies for controlling the production and marketing of sugar. This chapter is of particular interest to us in India at the present time as a plan for rationalizing the sugar industry in the United Provinces and Bihar has recently been put into operation.

The major part of the book is, however, devoted to the Indian sugar industry and its problems. The statistical tables given cover almost every aspect of the production and marketing of sugar in India. A very large number of the tables are illustrated graphically for the benefit of those readers who prefer that mode of presentation. The various sugar laws in the country are briefly summarized and their working described. An objective account is also given of the long drawn out controversy over the sliding scale of minimum prices for cane adopted by the Governments of the United Provinces and Bihar during the 1939-40 season. The existing system of marketing in India is described, and the importance of standardization emphasized. The closing chapters are given to summarizing the results of agricultural and technological research in India. Some valuable information is also provided in the appendices which give the texts of important legislative enactments on sugar, like the protection, the excise duty and the sugar factories control acts in the United Provinces and Bihar. There is also given a list of sugar factories in India and some financial statistics of sugar companies, as for example those relating to block capital, profits made, dividends paid and so on.

The material presented in this manual is comprehensive and authentic and the well-arranged index makes reference easy. It maintains the high standard of the publications brought out by the Sugar Technologists' Association of India and deserves to become an annual feature of the activities of the Association, as suggested in the Preface. —[R. C. S.]

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Fruit Culture

By Rao Saheb G. Jogiraju (The East Godavari Horticultural Society, Cocanada, 1941, pp. 32, As. 4)

FRUIT CULTURE is a very handy booklet treating briefly the principles underlying the cultivation of fruit crops with special reference to the conditions

prevailing in East Godavari district. The author gives broad hints in connection with the selection of soil, the preparatory tillage, propagation of fruit trees, care of plants before bearing and after bearing, disposal of produce and nutritive value of various fruits. The whole subject is treated in a very simple style in which it can appeal to the cultivator. The two appendices, one relating to the vitamin values and the other giving some information regarding the planting of fruit trees, are interesting and give useful information at a glance. It would, however, have been better if the subjects of manuring and treatments for flowering and fruiting were dealt with in greater detail with reference to each fruit crop. There are a few spelling mistakes here and there. On the whole, however, it may prove a useful booklet to the fruit growers in the Godavari district. The more appropriate title for this booklet would have been 'Hints on fruit culture' instead of the present title.—[G. S. C.]

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Handbook of Economic Entomology for South India

By T. V. Ramakrishna Ayyar, B.A., Ph.D. (Superintendent, Government Press, Madras, 1940, pp. 528, Rs. 4-12)

THIS is a timely book which will be of the greatest use to Indian entomologists. The first book on the insects of Madras, *Some South Indian Insects,* was published in 1914 by T. B. Fletcher, the Government Entomologist, Madras, during 1912-14, and later on the Imperial Entomologist, Pusa. Since then, there has been a growing demand, especially from students of agriculture and educated farmers, for a handy, up-to-date volume on South Indian insects, especially those of economic importance. Mr Ayyar's work represents an attempt to meet such a demand. It will be particularly useful to students of agricultural colleges because the plan of the book and the matter included in it form an elaboration of the college lectures on entomology which were given by the author to the students of the Madras Agricultural College for over 20 years. The book is divided into two parts : (i) the general part of six chapters briefly giving some fundamental ideas of insects and their various activities, and (ii) a special part including general discussions on insect pests, some of the control measures against them, and a brief annotated summary of the important insects of economic importance so far recorded from South India on different crops. There are useful appendices on classification and control given at the end of the book. Credit is due to the Superintendent, Government Press, Madras, for the neat printing and the fine get up of this useful volume. Mr Ayyar deserves the congratulations of all agricultural workers for this very useful handbook.—[S. C. R.]

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Udyama—Phalbag Visheshank

Fruit Gardening Number, January 1941 (Commercial Press, Dhantoli, Nagpur, annual subscription Rs. 3)

THE Fruit Gardening number of the *Udyama* magazine is a very creditable attempt to bring together the salient points of fruit growing. There are six articles on fruit growing, relating to the general principles of fruit growing, the cultivation of the mango, orange, fig, papaya, banana, grapevine and apple, the diseases of citrus and their control, marketing of fruits, etc. written in popular style. It also contains accounts of a successful fruit grower and a fruit merchant and these articles may go a long way to inspiring confidence in those who may think of starting the cultivation or marketing of fruits. Of course, the articles could have been written in a more detailed manner, but this special number will evidently serve the purpose of popular reading for which it seems to have been issued.—[W. J. J.]

From All Quarters

PUNJAB ESSAY COMPETITION

WITH a view to encouraging research into economic problems, the Punjab Board of Economic Inquiry is offering a number of prizes for original essays dealing with topical subjects of economic importance to the province.

The competition will be in two parts: (1) Results of personal field investigation, and (2) Articles based on published material such as is found in Government reports, and more particularly in the publications of the Board. Competitors may try for either or both parts, but the essays should not have appeared before in any magazine or proceedings, etc. The Board may, if they wish, publish any of the prize-winning or accepted essays which will become the property of the Board.

The essays should not exceed 20 typed foolscap pages (double-spaced) for Part I and 10 pages for Part II, although some allowance will be made for the former if the subject is of special interest and value.

The last date of entry is 31 October 1941, and the prizes offered are as follows:

	Part I Rs.	Part II Rs.
First prize	50	20
Second prize	25	15
Third prize	15	10
Accepted essays	5	5

The competition is open to all, whether resident in the Punjab or elsewhere, and entries should be addressed to the Secretary, 41, Lytton Road, Lahore.

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REFERENCES ON CROSS-BREEDING

THE editorial article in this issue deals with the use of Indian cattle for cross-breeding in other countries. Inquiries are frequently received for literature on cross-breeding. Here are a few references to publications which recount the experiences gained in India and other tropical countries in regard to the use of Indian cattle for cross-breeding work.

EDWARDS, J.—'Breeding for Milk Production in the Tropics'. (*Journal of Dairy Research*, Vol. III, No. 2. May 1932).

ELDON MOORE—'Animal Hybrids' (*Eugenics Review*, Vol. XXI, No. 4).

KARTHA, K. P. R.—'Comparative economic Efficiency of the Indian Cow and half-bred Cow and the Buffalo as Producer of Milk and Butterfat'. (*Agriculture and Livestock in India*, November 1934).

KARTHA, K. P. R.—'Milk Records of Cattle in approved Dairy Farms in India'. (Imperial Council of Agricultural Research, Miscellaneous Bulletins 18 and 36).

KELLY, R. B.—'Zebu (Brahman) Cross Cattle and their Possibilities in North Australia'. (Pamphlet No. 27, Council for Scientific and Industrial Research, Commonwealth of Australia).

MACGUCKIN, C. E.—'Cross-bred and Grade Dairy Cattle in India'. (*Indian Journal of Veterinary Science and Animal Husbandry*, Vol. VI, Pt. IV, Dec. 1937).

OLVER, SIR ARTHUR—'A Brief Survey of some of the important Breeds of Cattle in India'. (Imperial Council of Agricultural Research, Miscellaneous Bulletin 17).

WARE, F.—'The Cattle of India and their Development'. (*Empire Journal of Experimental Agriculture*. Jan. 1941).

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DEGREE FOR DR K. C. MEHTA

WE offer our congratulations to Dr K. C. Mehta, Professor of Botany, Agra College, Agra, who has been awarded the Sc.D. degree by the University of Cambridge.

For researches in the field of plant pathology, Prof. Mehta is the first person to get this distinction in India. He has carried out comprehensive studies for a period of 18

years on the rusts of wheat and barley which cause damage of over Rs. 6 crores annually in this country. Since 1930 this work has been done under the auspices and financing of the Imperial Council of Agricultural Research and with the help of several assistants.

Prof. Mehta has been able to suggest simple methods for the control of rust epidemics in the hills as well as the plains of India. These methods have been approved by leading scientists overseas and have been recommended to the provincial Governments and states concerned.

MGIPC—M—III-1-58—2-8-41—1,800.

INDIAN FARMING

ISSUED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II SEPTEMBER 1941 No. 9

ANIMAL PRODUCTION DURING THE WAR—AND AFTER

IN another place in this issue will be found an abstract of an article from the Journal of the American Veterinary Medical Association by the well-known veterinarian L. S. Merillat entitled ' Veterinarians in the National Economy '. The author shows the large part that animal industry has always played and will continue to play in the national economics of a country and the proper place, in his view, that veterinarians should take in any future planning that is done for the development of the different livestock industries.

The views that we hold in matters of organization are determined largely by tradition and the rather original viewpoints advanced in this article may come as somewhat of a surprise to some of our readers, but few will dispute the assertion, made in the same journal, that zootechnics and animal health must both be given prominence in any national planning of the future. This view, be it remembered, is advanced by those who are thinking primarily of industrialized countries in Europe and America, and if this is true of those countries it must be doubly so of a predominantly agricultural country like India.

Quoting from the same journal again, it appears that great apprehension is felt as to the fate of the pedigree herds of such well-known breeds of livestock as the famous Percheron breed of horses in France and the record-making Friesian cattle of Holland, both of which countries have been overrun by the Germans in the present World War. It is pointed out that those in a position to do so, realizing the importance of preserving such valuable assets as these pedigree animals will certainly prove to be when the war is over, will probably have taken steps to prevent their obliteration ; but in a total war anything may happen and it still remains to be seen what the actual position is in regard to breeds of livestock in ravaged Europe.

We in this country, at least for the present, are in a more favourable position and able to make our plans without undue haste and with due regard to the requirements of the future. The decision, taken a year ago by the All-India Cattle Show Society, to continue to hold its annual show at Delhi and the more recent one of expanding the show by adding classes for sheep and goats and holding regional shows during the cold weather of 1941-42 at Bhavnagar and Bangalore, is proof that this Society at least recognizes the necessity of preserving our best breeds of livestock during the period of the war. At the same time the Imperial Council of Agricultural Research is preparing authoritative definitions of the characteristics of the different breeds and is helping in the development of as many pedigree herds as possible by such measures as the introduction of herd-books and the formation of breed societies for the most important of them.

Built on such foundations and with the lessons of Europe before us, India's livestock industries, when the war is over, should be in a comparatively flourishing condition, for her best breeds should not only have been preserved but also developed. In addition, we should be in the desirable position of being able to trade our surplus animals with other less fortunate countries requiring an influx of tropical pedigree blood for the improvement or resuscitation of their own livestock.

J. H. G. JERROM

M.R.C.V.S., I.V.S.

An Appreciation

RECENT advertisements in the daily papers for a Director of Veterinary Services, Sind, remind us that another member of the Indian Veterinary Service is about to retire.

Mr Jerrom was born on 6 December 1886, entered the Royal Veterinary College, London, in 1903 and obtained the diploma of M.R.C.V.S. in 1907. After taking a postgraduate course in Pathology and Bacteriology at his own College the following year and passing the examination of the Royal Sanitary Institute for Meat Inspectors, he entered private practice, first as an assistant in Gloucestershire, and later on his own at St. Heliers, Jersey, Channel Islands.

In February 1915, during the course of the last war, he joined the Royal Army Veterinary Corps and went to Egypt with the 13th Division in June of that year and later was transferred to Mesopotamia. In July 1916 he was invalided to India where he remained until April 1920, and during that time was on camel purchasing duty for two years. After being demobilized, he returned to England and was appointed to the old Indian Civil Veterinary Department in 1920 and reached India again in 1921. He was immediately posted to Karachi as Superintendent, Civil Veterinary Department, Sind, Baluchistan and Rajputana, and except for a period of seven months in 1933, when he acted as Director of Veterinary Services, Bombay Presidency, he has been in Sind all his service.

In the above circumstances it is only natural that Mr Jerrom's name should be very largely identified with veterinary work in Sind, and in addition to bringing the Civil Veterinary Department of the newly constituted Sind province to its present state of efficiency, for some years he took an active part in racing in Karachi and acted as Veterinary Officer to the Karachi Light Horse from 1927 to 1933. He also had the advantage, during the course of his service, of attending two International Veterinary Congresses, one in London in 1934 and another at Zurich in 1938.

Owing to the distance and difficulties of the journey from Karachi to Delhi, his appearances at central meetings have been few, but his wide experience of the livestock of Western India has always proved a useful asset in debate.

Both Mr and Mrs Jerrom will be much missed in Karachi, and it will be the wish of all their friends that they may soon be reunited with their daughter, who has been stranded in Jersey since the occupation of this island by the Germans, and spend together a happy retirement.—(F. W.)

Original Articles

THE SOYBEAN—ITS POLITICS, PERFORMANCES AND POSSIBILITIES

By W. BURNS, C.I.E., D.Sc., I.A.S.

Agricultural Commissioner with the Government of India

THE soybean is more than a hardy annual. It crops up repeatedly in letters to the press, to the Imperial Council of Agricultural Research, and to the writer personally. The correspondents, in effect, say: 'Here is this wonderful plant. Why is it not being extensively grown and used in India?'

The soybean of commerce belongs to the family of the *Leguminosae* (i.e. the botanical order of the beans and peas). Its botanical name is *Glycine soja* (or, in America, *Soja max*).

Wide range of uses

An authoritative book (*The Soybean*, by Piper and Morse*) contains a chart showing the great range of products which can be made from the seed. These number 52. In addition to various food products (such as breakfast foods, canned beans, coffee substitutes, salad oils, edible oils, butter substitutes and milk powder) they include also soaps, paints, rubber-substitutes, explosives and glycerine. The green plant itself is important for pasture, hay and silage.

The chief countries of production are Manchukuo, Mongolia, Korea and Japan. It is being grown in increasing quantities in the U. S. A. and the Balkan countries and is being experimented with in South Africa, Argentina, Australia and India. The importance of the soybean to Manchukuo is emphasized by *Foreign Agriculture*, 1937 (a mimeographed journal produced by the U. S. Department of Agriculture) in the following words:

'The soybean is Manchuria's premier crop. In recent years it has accounted for about 25 per cent of the region's entire grain output, and it represents 30 to 35 per cent of the world soybean production. So predominant is the position of the soybean, bean cake, and bean oil in the trade of Manchuria, that these commodities constitute 80 per cent of the value of all agricultural exports and more than 53 per cent of the total value of all Manchurian exports. This indicates quite clearly that the soybean is not just a major crop but the very foundation upon which the economic life of Manchuria rests. Production of soybeans in Manchuria reached the peak in 1930 when it was estimated at 197,000,000 bushels. Since then production has declined by about 40,000,000 bushels. A decline in yield per acre is one of the reasons underlying this reduction. The average yield for the five-year period 1932-36 was 16·7 bushels per acre, against 20 bushels in 1924-28. It should be pointed out, however, that notwithstanding lower yields in recent years they are still higher than the five-year average of little more than 15 bushels* per acre in the United States.

Soybean production

Germany has always been a large taker of Manchukuo's export of soybeans, e.g. in 1938, the production of soybeans in Manchukuo was 4,673,000 metric tons, while Manchukuo's exports in the same year were 2,138,000 metric tons of which Germany took 770,600 metric tons, i.e. 36 per cent of the total exports of Manchukuo, and 20·8 per cent was bought by Denmark, Sweden and Holland combined. The United Kingdom took 100,300 metric tons amounting to 4·7 per cent of the total exports of Manchukuo. In the same year, 1938, production in the U. S. A. was 1,565,000 metric tons but in 1939 the production shot up to 2,045,000 tons. It is also a fact that, previous to the war, soybean had been gradually replacing groundnut in Germany's importation of oilseeds.

Previous to the present war a German-Rumanian Company, 'Soia', controlled by the German Dye Trust (I. G. Farbenindustrie) was founded in 1934 for the encouragement

* McGraw-Hill Publishing Co., New York, 1923.

* A bushel of soybeans=60 lb.

of the cultivation of soybeans in Rumania. The contract prices offered were such as to stimulate interest in the crop, so that in 1938 there were 156,000 acres soybean in Rumania. Similar methods brought about the cultivation in Bulgaria of 100,000 acres soybean in 1940.

Iron ration

A leader entitled 'Nazi Food Pills' in *The Statesman* about the end of April 1941 drew attention among other things to the use claimed to be made by the Nazis in developing from soybean an 'iron ration' for troops. This is probably based on an article which appeared in the London *Times*, dated 25 April 1940, entitled 'A Vital German Supply, the Magic Bean, the Soy, Food for Man and Beast'. From this article, the following extract may be quoted :

A SUBSTITUTE FOR MEAT

'The Germans are developing from the soya a flour called Edelsoja, which, because of its high content of good proteins (40 to 45 per cent) and of fats and carbohydrates, can completely replace meat or the other animal foodstuffs. This flour is introduced in the traditional prepared foods and culinary dishes (soups, sausages, bread, biscuits, macaroni) in such a way that the taste is unimpaired, the protein content greatly increased, and through a daily arrangement of diet the individual receives, without reliance on meat, the minimum ration of proteins, fats, and mineral salts indispensable for human nutrition. This soya flour is not an *ersatz*, not a 'food pill', but a new and superior foodstuff with the experience of centuries in the Far East to confirm its nutritive value.'

Spread in U. S. A.

Soybean was introduced into U. S. A. as early as 1804 but for a long time remained nothing but a botanical curiosity. Even in 1903 only eight varieties were cultivated in U. S. A. but in 1930 the area under soybean was 2,100,000 acres. This was due to its increased use for stock (in the various forms of forage, silage and for grazing) and to the greater use of the bean for human food. Since then, however, there has been still greater expansion both of soybean acreage and production and of its industrial uses. The following is requoted from 'Soybean Pioneer' (as condensed in *The Readers' Digest* from *Forbes*) in the June issue of *Indian Farming*:

'Uses still are broadening. The soybean is remarkably versatile because essentially it is 40 per cent highly digestible protein and 20 per cent fat, which crushes out as oil. Of the oil produced, 85 per cent now goes into human food products, the rest into paints, lacquers and soaps. About 95 per cent of the meal goes into livestock feed. New products ranging from cocktail crackers to plastic articles, such as the knobs and buttons Henry Ford makes for his cars, appear constantly, but the bulk of the crop is used for food, feed and paint.

'There is no sign that the soybean's potential market in the United States is near saturation. The Government estimates a 17 per cent acreage increase this year, which means a 100,000,000 bushel harvest. Even without new uses, Staley believes present markets can absorb 150,000,000 to 200,000,000 bushels annually.'

In the *Monthly Bulletin of Agricultural Science and Practice* (Rome), 1936, there are listed and described no less than 183 varieties of soybean grown in the U. S. A.

Commercial exploitation

An authoritative publication on the commercial exploitation and commercial processes involved in manufacturing soybean products is the book, *The Soybean Industry* by A. A. Horvath*. For any one desiring to start the manufacture of any product from soybean, this is a handbook of fundamental importance. Among the many products mentioned is lecithin. From other sources we learn that from about 1926, in Germany and Denmark, mills for the commercial extraction of lecithin were put into successful operation and that over one million lb. of soy lecithins was used annually in Germany for the production of margarine. Low-priced lecithin was also manufactured and put on the market by a Japanese concern. Horvath also gives a formula for making plastics from soybean and makes the following statement regarding the manufacture of such plastics in one of Ford's motor works in America :

'Ford's welding is being done in a part of the huge glass works at his River Rouge plant. In the main building are housed the mixing equipment and moulding machines capable of turning out 100 tons of plastic per day in the form of distributor parts, gear shift lever knobs, light switches, horn buttons, coil parts and window frames. The total outlay represents a construction and equipment cost of approximately $4,000,000.'

In the British Empire

In 1908 when the first large-scale importations began to be made into Europe, soybean

* The Chemical Publishing Co. of New York, Inc., second edition, 1939.

was admitted into England without tariff, while the other countries imposed an import duty. When the other countries recognized the disadvantages of this imposition, they cancelled it and England then lost its premier place as a soybean importer. England withdrew soybean from its free list in 1935 in order to give effect to the principle of Imperial preference. Sir Philip Cunliffe-Lister, then Secretary of State for the Colonies, emphasized that every colony producing palm kernels, groundnuts or soya beans had asked for this preference owing to the increasing competition in soybeans. He hoped that the preference would stimulate the production of soybeans in the territories concerned. There was certainly ground for hope that there might be commercial production of soybeans within the Empire.

The story of the successful introduction and cultivation of soybean in England is told by Elizabeth Bowdidge in a book *The Soya Bean.** This success was obtained by Mr North on the Ford Company's farm at Boreham in Essex in 1933 and 1934. Soil inoculation and plant acclimatization were necessary but success was obtained and yields of from 15 to 25 bushels per acre were got. Soybean cultivation has not yet, however, spread in England. As an imported crop it has been used as a food for farm animals, and until the outbreak of the present war a part of the imports was converted into flour, oil, etc. as well.

Soybeans in Germany

Under the auspices of the Forschungsdienst (the All-Germany Agricultural Research Organization) research on soybean in Germany itself was much speeded up in the years 1934-37. Attempts to introduce soybean into German cultivation had up till then been a failure, mainly for the same reason that keeps it from spreading in India, i.e. its low price on the world market. The fixing of a more attractive price for soybeans grown in Germany and a greater appreciation of their nutritive value put a different complexion on the matter. Scientific work has been mainly in the direction of plant breeding, one institution dealing with no less than 30,000 single plant cultures. The plant breeding work has shown that the supposed antagonism between high fat and high oil content does not always exist, and that it may be possible to breed varieties that are high in both. On the agricultural side the following are some of the results obtained:

(1) Drill sowing is better than broadcasting.

(2) Thick sowing accelerates maturity. Breadth between rows should not exceed 50 cm. (=20 inches). The lighter the soil the smaller the space between the lines, but not less than 35 cm. (=14 inches). In the rows the best distance between plants is 10 cm. (=4 inches).

(3) Seed-rate should be not less than 15 kilograms per $\frac{1}{4}$ hectare (67 lb. per acre).

(4) Soybeans can be successfully grown as a mixed crop with early potatoes.

It is to be noted that these recommendations are for German conditions and might not suit India.

Nutritive value

The chemical composition of the soybean, particularly its high protein content, has caught the imagination of many uplift workers in India, and they have done their best to get this bean grown and introduced into Indian diets where there is a protein deficiency. The letter from *The Statesman* of May 1, 1941 quoted below is a good recent example. This is typical of many efforts that are being made:

'Sir,—We were interested in your recent leading article entitled 'Nazi Food Pills', and in other recent references to the soya bean in your columns. For the last three or four years we have grown soya beans at first in our garden, and last year on a somewhat larger scale in the hospital compound. The yield in the garden was excellent, but as the hospital plot was previously uncultivated waste land the yield was relatively smaller. We are situated in the Kond Hills (Ganjam Agency) at an altitude of just over 2,000 ft. The rainfall is moderate, soil rather heavy.

'Our purpose in cultivating soya beans is to supplement the deficient diet of our hill people who are soaked with malaria and are on the whole small and of poor physique.

'The soya bean is rich in first-class proteins (those yielding all the amino-acids essential to maintain life), fats, minerals, and vitamins A and B. We are using our crop in hospital to supplement diets of under-nourished children and those suffering from diseases causing tissue wastage. The bean can be eaten fresh or dried, our hospital stock being dried. When used dried, soaking overnight in cold water is necessary. In either case the beans are boiled gently

* Oxford University Press, London, (1935).

for at least four hours with a little salt in the water which is not thrown away but used in soup. Patients eat the beans with their rice at their midday meal and relish them. For Europeans we find that soya beans are nice either as a cooked green vegetable, or dried beans soaked as above, pounded when half cooked, mixed with an equal part of *dal* and served as cutlets or savouries, which have a pleasant nutty flavour.

'As the beans become more widely known we hope to encourage villagers to cultivate them. We have not touched on the commercial and economic aspects of soya cultivation, but believe that there are possibilities that might well be developed up here. The provincial Director of Development is interested and will no doubt investigate this matter. But we think that the villager who grows it on a small scale would do better to eat it, as if he sold it on what better food could he spend his money ?

'We hope that many of our readers in all parts of the country will be stimulated to experiment for themselves in the cultivation of this bean, and we believe that there will be far-reaching results in the health and welfare of the Indian peasant.—Yours etc., (Dr) E. Gordon Wilkins, (Dr) Honor E. C. Wilkins, Moorshead Memorial Hospital, Baptist Mission, G. Udayagiri, Ganjam, April 13.'

A strange fact

This frame of mind is not confined to uplift workers. An agricultural chemist who is a friend of the writer sent him recently the following letter :

'I find that the explanation of why soybeans are not grown more than they are, in India, is because there is no market for them. Now in these days of deficient dietaries, financial stringency and other economic factors connected with the War, it does seem to me to be a very strange fact that there is no market for one of the most nutritious foodstuffs both for humans and animals in this country. You are probably aware that the diets of the Japanese and Chinese armies consist to a large extent of soybeans. You will notice that in the United States from 150 to 200 million bushels could be utilized annually, and that the German firms had contracted for the soybean crop in Russia from a million acres.

'Here is a produce which can be easily grown, easily transported, without deterioration, and for which in these days there ought to be an almost unlimited demand and yet it is not grown because we are told that there is no market for it. I myself take soybean in vegetable curry two or three times a week and it is a most excellent food containing 40 per cent of highly digestible protein, 20 per cent of fat and it is also rich in several vitamins.

'We ought to be supplying this to the army in large quantities. In addition there are many industrial products which can be manufactured from the soybean and which are manufactured in other countries but not in India. I suggest that we ought to consider the soybean for India and get down to the problem of propaganda and the production of the soybean and soybean products on a considerable scale.'

There is another side to this nutrition question.

Comprehensive tests

Sybil Woodruff and Helen Klaas in *A Study of Soybean Varieties with Reference to Their Uses as Food* * state : 'The literature on the nutritive value of soybeans is either incomplete or conflicting to such a degree that comprehensive laboratory tests with present-day technics are needed.' Such tests have been carried out at the Nutrition Research Laboratories, Coonoor, South India.

In 1937 the Nutrition Advisory Committee of the Indian Research Fund Association after considerable discussion arrived at the following conclusion :

'The nutritive value of soya beans had been studied by experiments on animals and also by controlled experiments on school children. The general conclusion was that soya bean considered as a supplement to typical Indian diets was not of outstanding value ; it did not appear to have any advantage over the various common pulses which have long formed part of the diet of the Indian people. Existing data suggested that at present the encouragement of the production and consumption of soya bean need not be made a prominent part of nutritional and agricultural policy in India.'

Further experimental data accumulated in India since then bear out these conclusions. In particular it is proved that no vegetable protein can compare with animal protein (e.g. such as that found in milk) in its nutritive properties.

Doubtful palatability

On the subject of palatability there is a very considerable difference of opinion which may be based on different ways of cooking the soybean and also perhaps more so on the amount of other foods with which the soybean is mixed. Various acquaintances of the writer have expressed feelings little short of disgust regarding the taste of soybean preparations while the evidence already quoted shows that others have no such reactions.

It is noticeable that recipes given in books usually contain only a small proportion of the bean and numerous other ingredients to add to palatability. Many of these recipes are too elaborate and expensive for use in India.

In those eastern countries where soybean is an important food, soybean products are

* University of Illinois Bulletin, No. 443, 1938.

Here again it is doubtful whether the popularization of processed soybean flour would really improve the national diet.

Cultivation of soybean in India

E. J. Woodhouse and C. Somers Taylor in 1913 wrote a paper entitled 'The Varieties of Soy Beans found in Bengal, Bihar and Orissa, and their Commercial Possibilities'.* In this they came to the conclusion that the Darjeeling varieties were probably originally obtained from China through Tibet, and had thence spread into the plains where only the types best adapted to plains conditions had survived. The cultivation of soybean was then carried on only to a slight extent in the Darjeeling hills and to no appreciable extent anywhere else, though satisfactory yields had been obtained by the Agricultural Department in both hills and plains areas.

In addition to the Darjeeling district of North Bengal, soybean is grown also in Nepal, Bhutan and Sikkim, the total area in all these places being probably about 20,000 acres. It is also grown in the Kumaun hills. In addition to this there has been experimental cultivation in almost every part of India and soybean has been grown in the Punjab, Bengal, Bihar, Orissa, Assam, the Central Provinces and Berar, Madras, Bombay, Baroda, the United Provinces, Sind, Mysore and Kashmir. The Agricultural Departments of several of these provinces and states have issued leaflets giving directions for its cultivation. Such are the Punjab Agricultural Department leaflet No. 146 'Soybean Cultivation in the Punjab': the Assam Agricultural Department leaflet No. 1 of 1938 'Soybean', and the Bihar Agricultural Department leaflet No. 5 of 1937. Copies of these leaflets can be had by application to the Director of Agriculture in each province. In other provinces, the Director of Agriculture will give similar information if asked. Madras experience is summarized in an article 'Soy Bean Trials in Madras' by M. Anandan in *The Madras Agricultural Journal*, September 1940. In Madras an annual rainfall of 40 inches and deep alluvial soil seem to be necessary. Insect attack (by the insect locally known as *surul* and to science as *Stomopteryx nerteria*) is severe in many places. Yields were from 350 to 2,000 lb. per acre. Cultivation methods naturally differ from place to place, but the following is a rough outline of the general procedure:

Cultivation procedure

Soil.—Soybean can be grown on most soils, but does best on rich loamy soils.

Soybeans require a particular kind of bacteria in the soil for their proper development and the crop sometimes fails in a new area for lack of these bacteria. This was so in England where success was obtained only after the bacteria had been introduced from abroad by means of soil in which soybean had grown. The use of such soil is the easiest way of inoculation, and one pound of such soil mixed with a bushel (60 lb.) of seed is sufficient to do the inoculation. In India, on the whole, inoculation has not been necessary, probably because the soybeans carried on their surface enough of the bacteria to do the inoculation.

Tilth.—Moderately deep cultivation (say about six inches) and fine tilth are desirable, such as would be obtained by three or four ploughings with a country plough.

Manure.—This is not essential but eight to ten cartloads of farmyard manure per acre is a considerable help.

Time of sowing.—Soybean is generally sown as a *kharif* crop (i.e. sown at the break of the monsoon in June or July).

Seed-rate and method of sowing.—The seed-rate is from 20 to 30 lb. per acre in rows two feet apart and with seeds from three to twelve inches apart according to the variety, at two inches deep in the soil. (In Sind, trailing varieties are sown in rows three feet apart, and with nine feet between the plants).

Watering.—Throughout the greater part of India the crop can be grown on the rainfall. In the Punjab and Sind it needs watering every 15 to 20 days in absence of rain.

Harvesting and yield.—If sown in June or July the crop is ready for harvesting for grain about December or January. In India the yield per acre is between 500 and 1,000 lb. seed.

Use as fodder.—Soybean plants can be cut

* *Memoirs of the Department of Agriculture in India*, Botanical Series, Vol. V, No. 3.

green before the seed ripens and used as fodder. Up to 10,000 lb. green fodder can be obtained after three months, with a reduced grain yield from the second growth, in irrigated conditions. Soybean is also a good folding crop, i.e. one on which animals can browse.

Varieties.—In the matter of the variety to be grown, the advice of the local Agricultural Department must be relied on, but one of the most generally successful has been the variety known as Mammoth Yellow.

Some non-official experience

Mr M. R. Dokras, B.A., LL.B., of Chandur, Berar, published a small pamphlet in which he gave his experience of growing soybean since 1916. He sowed in June or July using as low as 12 lb. seed per acre for a grain crop and up to 30 lb. for a hay crop. His crop stood 60 inches of rainfall and seemed to do best in heavy rainfall years when the cotton was ruined. Even when waterlogged and unweeded for a long time 500 lb. seed per acre was got. In a really good year 2,000 lb. grain per acre was obtained.

Mr George A. C. Hearsey has, since 1936, grown soybeans on his place—Palia Ranch, near Palia Kalan Station, R. & K. Railway, Oudh. No inoculation was used. In 1937 he harvested 185 maunds from 45 acres, an average of just over 4 maunds (330 lb.) per acre. He found certain varieties of the soybean stood up to flood conditions. The growth periods of three varieties were :

Mammoth Yellow	145 days.
Medium Yellow	115 days.
Virginia Brown	125 days.

His dairy cows ate greedily the dried soybean plants and soybean *bhusa*. This shows that soybean *bhusa* could be a valuable addition to available roughage for cattle.

In 1940 Dr W. Thompson, of St. Luke's Hospital, Chabua, Upper Assam, grew for the first time soybean supplied by the Assistant Director of Agriculture, Shillong. Two sowings done in August ripened together and gave a heavy yield.

Economics

In 1934 a Crop Planning Conference was called in Simla by the Government of India, when consideration among other things was given as to what new or substitute crops should be encouraged. Notes were submitted by various Directors some of which reported that soybean could be grown quite well in their provinces or states but that the price was so low that it was not worth while to try to produce it. For example, writing in 1934, the Director of Agriculture, Sind, stated that the quotation then was Rs. 15-8 per candy ($658\frac{2}{7}$ lb.) f.o.r. Karachi which was definitely too low to induce cultivators to take to this crop. The soybean grows in almost all the hill districts of Assam, but as the price obtained is very low (it is only an anna a seer in the Naga Hills), there is no inducement to extend cultivation. The Director of Agriculture, Punjab, said that with the price at Rs. 7 per maund soybeans would pay better than cotton, but that he found the price might sink as low as 12 annas a maund. In 1938 United Kingdom prices were roughly £8 a ton. Allowing for freight at 25 to 30*s.* a ton and also allowing for the 10 per cent preference then in force, this would work out at about Rs. 3-8 per maund at an Indian port.

In the same year groundnut prices per ton in Britain were roughly £3 higher than those paid for soybean. Since 1938 soybean prices have risen steadily and from July to December 1940 were £15 a ton in London with groundnut at £14-10-0 to £17-6-3.

It is not likely that the price of Rs. 3-8 per maund would be attractive to any grower, but prices corresponding to £15 per ton in London might be so. There is no large market for soybean *for use in India* because there are not in India any of the many industries based on soybean (as exist in America and Germany). For export purposes lots of at least a thousand tons would be required and that means large-scale cultivation, only possible if the price were attractive, so the circle closes again and will remain closed unless it is worth someone's while to guarantee over a sufficient period a price that will induce cultivation. It is not an impossibility to introduce a new crop into India (the history of groundnut in India shows this) but the new crop must put more money into the pocket of the cultivator than the crop it is going to replace.

As regards an extension of soybean cultivation for the purpose of improving the diet, it is a difficult thing to change the dietetic habits of the people, particularly when there are already in use pulses to which they are accustomed. This does not, however, rule out the possibility and even desirability of introducing soybean in places where no pulses are grown, and where the diet of both men and animals needs a pulse addition. Soybean may be particularly useful in areas where ordinary pulses do not grow well, as for example in areas over 5,000 ft. or in places liable to waterlogging.

ANIMAL HUSBANDRY IN ANCIENT INDIA—I

By A. Krishnaswamy, G.M.V.C.

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ALL the historians are agreed that when the early Aryans settled down in India, they settled as agriculturists, and that they appreciated the importance of cattle as one of the most indispensable adjuncts of agriculture. In fact, cattle formed their chief property. It constituted a part of their national wealth. The pride and joy of a cattle owner is well described in the *Dhaniya Sutta* of *Sutta Nipāta*, where Dhaniya is said to have owned 30,000 cows of which 27,000 were milked every day. The anxiety of the early Aryans for the safe keeping of their cattle is evident from many of the hymns in the *Rig Veda*. The primitive Indian feeling for the cow is very beautifully and naturally portrayed in hymn 19 of Book X of the *Rig Veda*, where a prayer is addressed to the gods Agni and Varuna for the safe return of their cattle from the grazing area. The importance of the cow among the early Aryans of India is evidenced by the fact that the so-called families and groups of families, which form the chief backbone of the social life of the Hindus of today, have taken their origin from the Sanskrit word *go* which means a cow. It is very interesting to read the findings of Dr Das, in this connection, that the early days were very insecure and that, for the protection of their cattle against wild beasts and robbers, several families entered into a mutual understanding to erect a common enclosure for their cattle. Those families which possessed a common cattle enclosure formed one *gotra* and a group of such *gotras* which held a common pasture-land formed one *goshthi*. The literal meaning of the words *gotra* and *goshthi* is common cow-shed and common grazing ground respectively. Thus a common interest in the cow furnished the true basis for the birth, growth and development of the socio-economic life in primitive India, which forms the structural backbone of the Hindu society of today.

Use of animals in agriculture

Horses could be used for drawing ploughs, but there is no evidence of their having been so used. The fact that horses were unfit to draw ploughs in muddy and miry soil probably made them unimportant for agriculture. Oxen took their place and were considered indispensable for agricultural work. In the *Rig Veda** we find horses being used as animals of draught to draw cartloads of corn. Bullocks and buffaloes were also used as beasts of burden and for drawing carts and caravans.

It is well known that horses and elephants formed the chief paraphernalia of all the kings and nobles. They played an important part in battles. Bullock- or horse-drawn chariots (*ratha*), elephants (*gaja*) and horses (*turanga*) constituted three of the four main parts of an army for warfare; and bullocks formed the chief means of transport of war materials.

Supply of animal products

The animal kingdom served a very useful purpose in the Materia Medica of the Hindus since very early times.

Milk was known to them to be highly nourishing, cow's milk was necessary for daily consumption and for offering oblations to God. Both cow's milk and buffalo's milk were used for preparing butter, ghee, curd, and various kinds of sweetmeats and cakes. Cow's milk, goat's milk, sheep's milk, ass's milk and camel's milk were widely used in medicine.

Cowdung was necessary for manuring the fields and for use as a disinfectant in the

* Book X 101·7.

common Hindu household. In order to ensure a uniformly slow and steady heat for the preparation of several ayurvedic medicines, dried cowdung was found indispensable for the druggist's furnace.

Hot fomentation of cow's urine was found to be an infallible remedy for hepatic inflammation. It is not known whether in the Vedic period bones were used as manure. But from the *Brihat Samhita** and the *Arthasastra*† we find that, in later times, the use of bones as a fertilizer for the soil was well realized.

In the Vedic age, people had no objection to eating beef. In the epic period also, beef and buffalo-meat were freely used by the people. Digha Nikaya‡ speaks of a beefstall in a prominent part of the city. Hides were tanned and made into leather vessels for carrying water.

Bone of a goat reduced to ashes and made into an ointment with other ingredients was used for curing fistula. The tusk of an elephant was usefully prescribed for leucorrhœa. Poison of the ordinary cobra and of the snake-eating black cobra was advocated for dropsy. Fat of lions and tigers was found to be a specific for paralysis. *Meda* or fat of camels and hyena was considered a valuable remedy for gouty joints. Feather of a peacock was said to cure cough. Bone marrow of a panther was recommended as an effective cure for chronic rheumatism and sprains. Horn of a stag had various medicinal uses. The medicinal virtues of the urine of a cow, elephant, horse, camel and goat were known to the early Hindus. Conches, cowries and corals and their several compounds were widely used in medicine. Bile of fish and other aquatic creatures was found to be sure remedies for moon-blindness or night-blindness.

Droppings of cockerels and goats were reported to have several curative properties. Snake skins had their own medicinal values. Leeches were widely in use in vinesection and for blood-letting. Of honey, six different varieties were recognized, each having its own specific medicinal value. Gall-stones of cattle were considered specifics in diseases of the respiratory organs. Musk obtained from a kind of deer called musk deer was the best specific for cardiac troubles and collapse of the heart.

These were the several animal products well known to the ancient Indo-Aryans.

(*To be continued*)

* Chapter 55-17-19.
† Book II Chapter 24.
‡ Vol. II.

DRYING OF FRUITS AND VEGETABLES

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THE drying of food has been practised since the beginning of civilization and still remains a popular means of preserving many different kinds of food, such as fruit, vegetable and meat.

Drying is one of nature's own processes. It is shown in the drying of grains such as wheat, corn and many other seeds. Nature's methods have been improved by the application of artificial heat, which hastens the process. This is used for perishable products, which under natural conditions could not be kept. But in India the climatic conditions are mostly favourable for sun-drying and there is very little chance of spoilage. The temperature is sufficiently high in summer and, moreover, the atmosphere is not always humid, both of which help in rapid and successful drying of fruits and vegetables.

Economy of drying

Foods produced in this way are less bulky and require less space for storage than in fresh natural condition. First-grade dried fruits and vegetables are about as expensive as the same product would be if canned, but they are lighter in weight, require less space in shipping and can be packed in less expensive containers.

Vegetables as compared to certain fruits are perishable, though fresh vegetables are preferred, but now, considering the international situation, it has become difficult to supply fresh vegetables. Only dry vegetables can do owing to less bulk and weight.

Favourable conditions in India

Fruit drying is an important industry in California, Australia, Greece, Asia Minor, Spain and Afghanistan. In America about 0·4 million tons of dried fruit used to be produced 15 or 16 years ago. The production seems to have increased and some people estimate that about 75 per cent of the fruit is dried in America. Figures for other countries are unfortunately not available. In India most of the dried fruits are imported from Persia and Afghanistan, but they are of poor quality as compared to American fruits. This may be attributed to the fact that in America drying is by sulphur dioxide, whereas in Persia and Afghanistan primitive methods of drying, still in vogue, are responsible for considerable loss of colour and flavour. Besides, the dried fruits are susceptible to the attack of insects. It is estimated that dried fruits to the value of Rs. 50,000 roughly are imported in India from America alone. It is said that conditions for fruit drying are even more favourable in India than in America. The bright sun provides a natural oven and free air for fruit drying almost throughout the year. The fruit should undergo a few processes preparatory to exposure to the sun. Such processes accelerate the rate of drying, thereby helping in the retention of colour and flavour. Properly dried fruit retains the flavour of fresh fruit, which can be regained by proper treatment. This is also true of vegetables.

Dried fruit occupies less space, is lighter than either fresh or any other form of fruit preserve, and hence can bear freight, requires less expensive containers which can be locally made from wood or cardboard as compared to tin containers of other preserves which have to be imported from abroad. Now owing to the international situation there are no cans available in the market, and if there are any, they are beyond the reach of even well-to-do zemindars.

Drying does not require much capital outlay; only a sulphur house and trays are sufficient. Above all, it does not require sugar for preservation.

Fruit orchards are no longer laid out merely for luxury. The technique of fruit drying is explained below.

How peaches are dried

Only free-stone varieties of peaches are sun-dried. They are dried with the skin attached and without washing unless they have been soiled by contact with the ground. The fruit is cut by hand. A sharp knife should be used and a cut made completely around the suture; care should be taken to avoid tearing of the fruit when the halves are separated and pit removed. Many cutters will tear soft fruit apart because it is easier or quicker, but this results in a product with rough edges and poor appearance. The halves of fruit are laid on trays, close together and with the cups upward.

The trays are then stacked in the sulphur chamber for exposure to the sulphur fumes. They are left in the sulphur house overnight, but usually the sulphur does not burn all night. To secure and retain the best commercial colour, peaches when dry should contain at least 1,500 parts per million of sulphur dioxide. About $8\frac{1}{2}$ lb. of sulphur is required per ton of fresh peaches.

Bright golden colour was got in 3A & 6A varieties, which is still capable of improvement. Elberta has the best flavour.

There is still room for improvement in quality of fruit and colour. The fruit is quite good for stewing, pudding and dessert purposes.

Plums and pears

Plums are quite good for stewing. Rubio tops the list with regard to quality, followed by No. 3. No. 1 being too watery had air blast left in the fruit. The fruit of Federation and Ogan is stiff and the latter is also a bit leathery.

There is scope for improvement in texture and colour of fruit.

Sulphuring improves the colour, and dipping in 0·4 to 1·2 per cent lye solution for a few seconds accelerates the rate of drying.

Leconte, Keifer and Batang pears were tried. Leconte could be ripened in *bhusa.* The second and third varieties were tried on a small scale. Leconte pears have very attractive colour and palatable flavour but small size and less substance. In Leconte, percentage of dried fruit to raw fruit came to 10·83 and to cleaned fruit 14·8.

Choice of fruit

Certain general consideration affects the choice of fruit to be dried. As a general rule, sun-drying is a primary industry, some fruits being grown almost or quite exclusively for drying. Hence the fruit used is not low-grade. This is the case in foreign countries, but here in India this stage has not yet been reached. We only dry the fruits and vegetables which are not easily marketed. Free-stone varieties of peaches are generally dried, but clingstone varieties are used almost exclusively for canning. Prunes can also be successfully dried.

Cultural practices

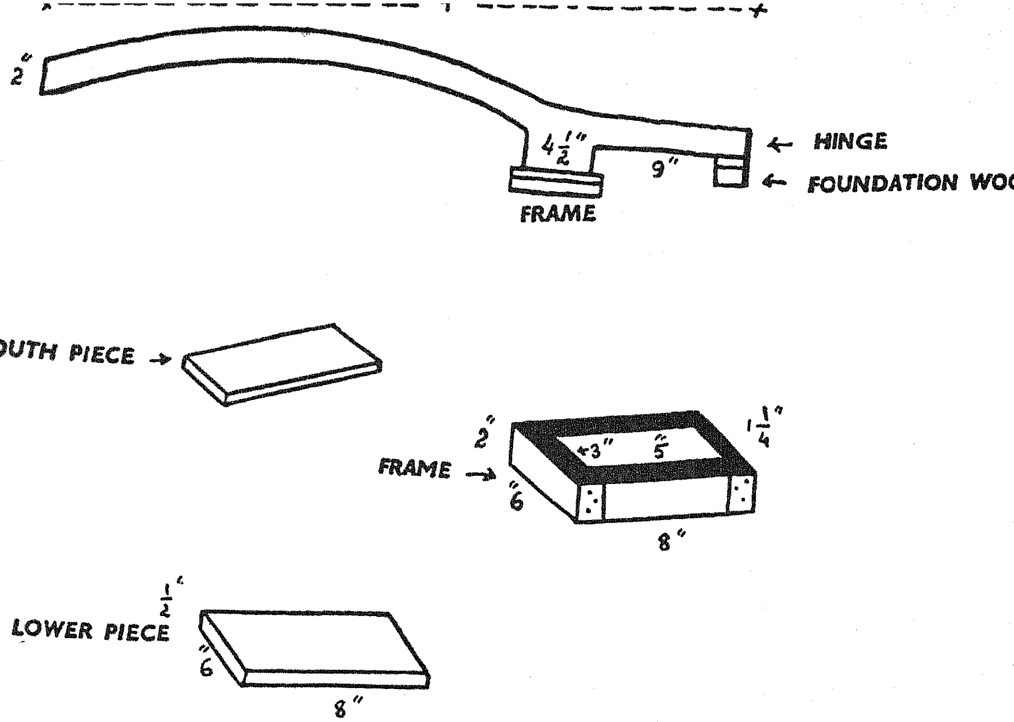
In the production of dried fruits of high quality the first essentials are suitable cultural practices, maturity and harvesting. Size is an important factor in quality of dried fruit, thinning seems to be done least effectively. Such an increase in size as to double the market value is often possible, and since the cost of drying a crop increases with the size of the crop, it may be far more profitable to produce a small crop of high quality than a large crop of poor quality.

Maturity

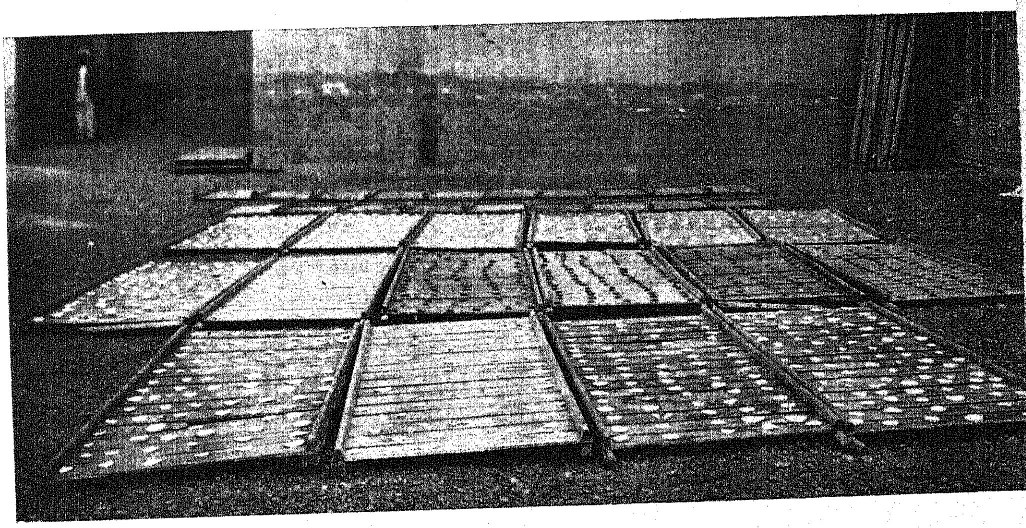
The maturity of the fruit for drying is also of vital importance. In order to produce the best possible dried product, the fruit must be of fully developed flavour, well coloured and of maximum sugar content. In short it should be in proper condition for eating in the fresh state. If it is hard or green, it yields a product of poor appearance, colour and flavour, with a high shrinkage ratio. These effects are especially apparent in apricots, peaches and raisins, although they are of importance in all fruits. Pears are picked hard and are allowed to ripen afterwards.

Harvesting

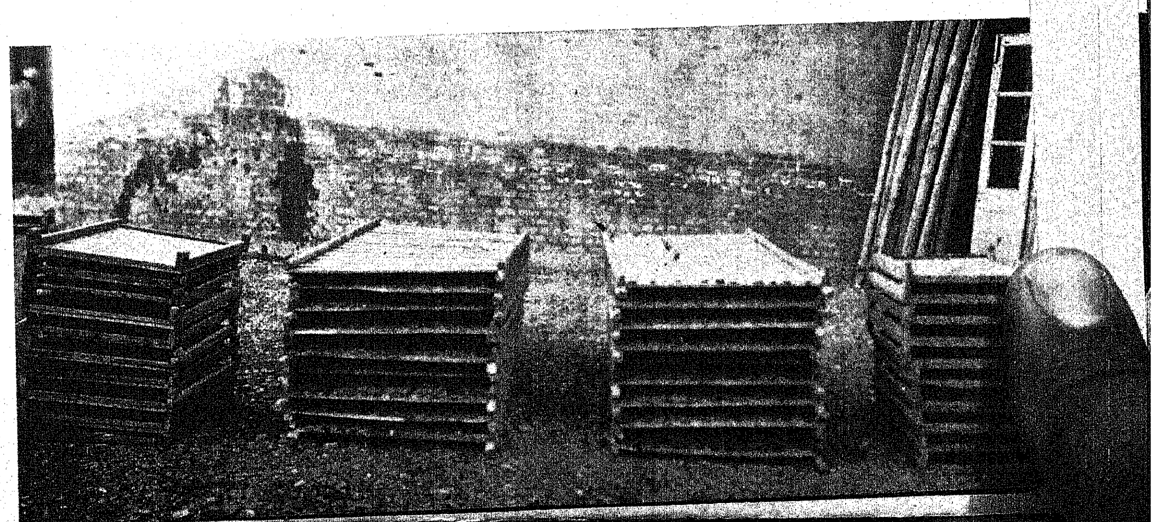
Soft fruits like peaches, plums and apricots should be picked when they become slightly soft to the touch over the entire surface and if slightly bruised the flesh darkens quickly. They should therefore be handled with great care and should be cut and spread as soon after picking as possible. Several pickings



Drawing of a wooden press used at Tarnab Farm



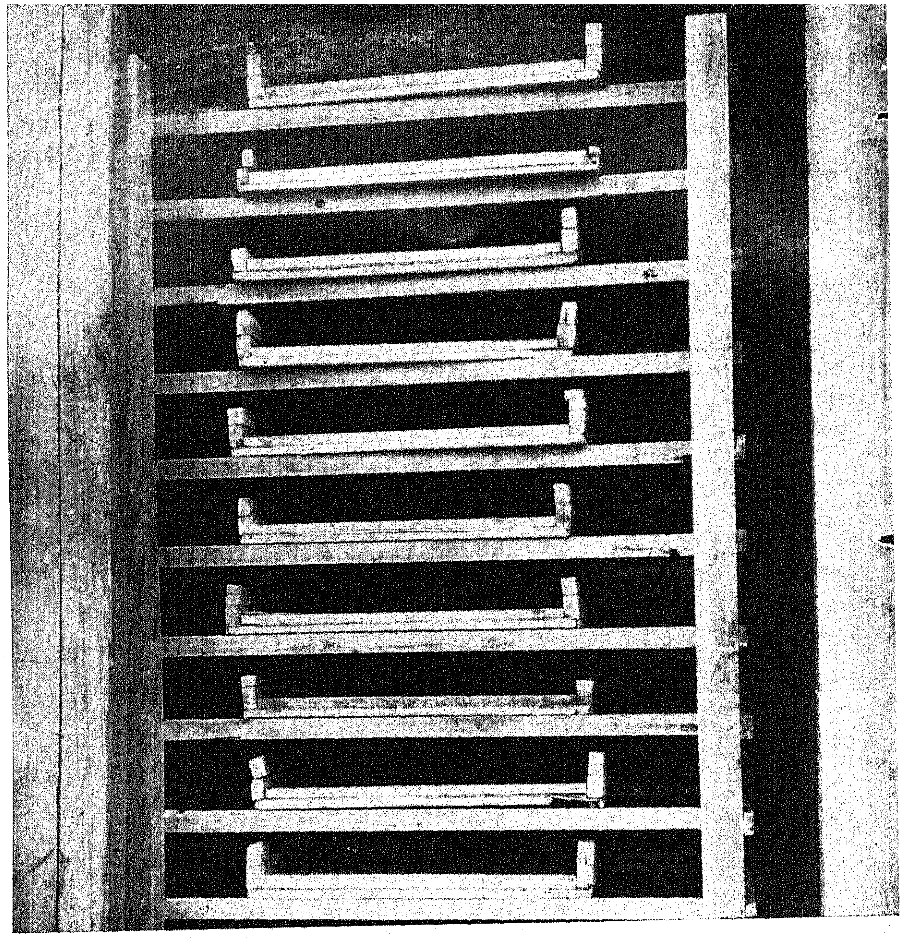
Fruit trays in the drying yard

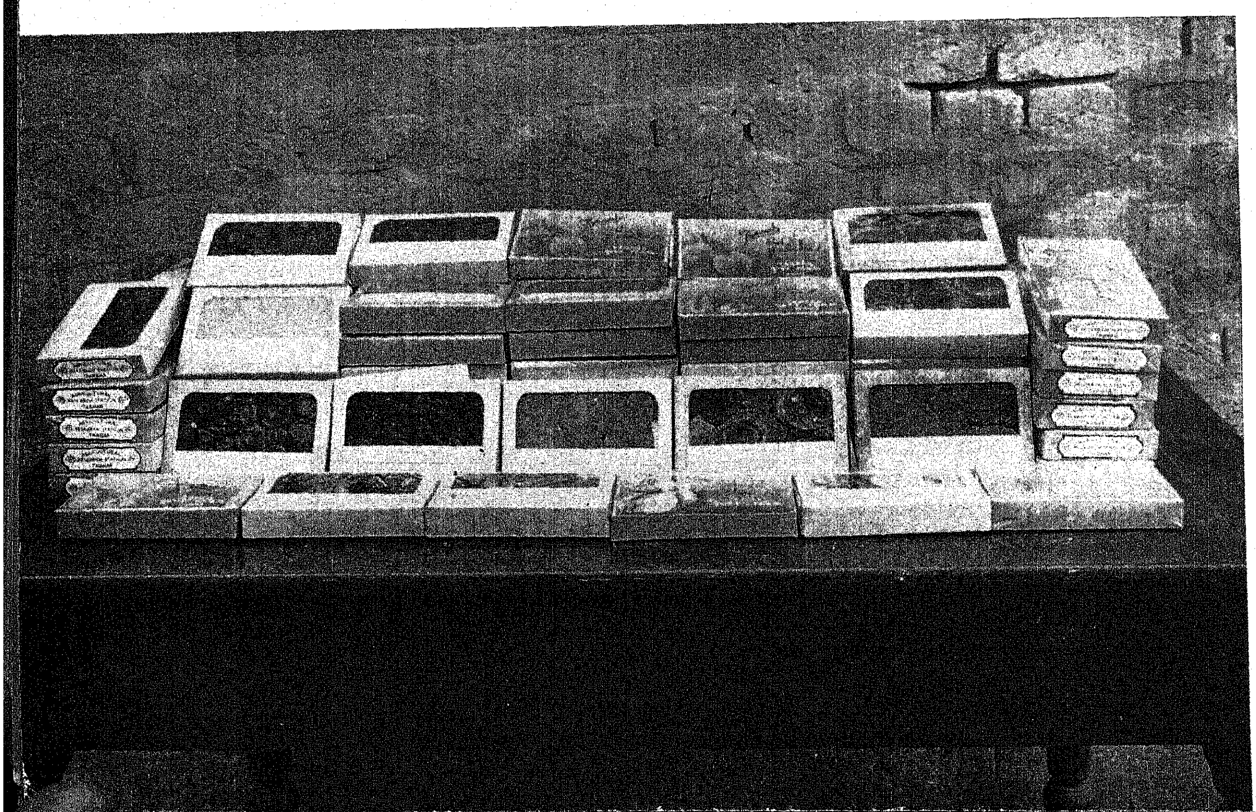


Stacking of trays for wind drying

Right : Sulphur chamber

Below : Packets ready for disposal





should be made during the season in order to ensure a dried product of the highest quality. Shaking results in bruising the fruit which affects the quality of the dried product. In handling the fruit shaking should be avoided and it should be picked by hand in order to ensure the best quality. The wisdom of shaking at all costs is doubtful because of the resulting loss in quality and yield and the necessity of washing, together with the added cost of drying and removing worthless fruit.

Preparation for drying

This includes the elimination of waste parts as far as possible, and the rejection of pieces that are unacceptable. It also includes any cutting, pitting, lye-dipping, sulphuring or any other treatment necessary to make the fruit dry rapidly and without decomposition or objectionable change in colour. Preservation by drying depends upon the reduction of the moisture content so low that bacteria and fungi can no longer grow upon and damage the fruit. The reduction of moisture content alone does not always lead to the retention of sufficiently attractive and stable colour. To achieve this end some fruits are subjected to the fumes of burning sulphur through which a harmless fruit preservative sulphurous acid is introduced. This not only stabilizes the colour and protects the fruit against micro-organisms, but helps to retain some of the vitamins for which fruit is especially valuable in the diet.

Equipment for drying

Much of the equipment required for sun-drying can be and often is used for several different fruits.

One acre of drying yard is required for 10 to 30 acres of orchard, the ratio is generally 1 : 20. The yard should be free from shade and well exposed to prevailing winds. It is necessary that the surface of the yard should be free from loose dust, sand and chaff. It should be away from dusty roads and should be effectively fenced against animals. There should be a permanent cutting shed in one corner.

The sulphur house should be of simple construction but it must meet the following requirements:

1. It should be free from leaks in order to secure an effective concentration of sulphur dioxide and prevent waste of sulphur.
2. It should be provided with a draught that can be controlled.
3. It should not be too large to permit a reasonably uniform concentration of sulphur dioxide to reach all points in the house.

The sulphur chamber must accommodate at least 20 to 25 trays.

Sulphur used should be free from arsenic or oil and should have no sooty residue. Only sulphur flours of good brand should be used. If by chance the combustion of sulphur is incomplete, it can be remedied by allowing more air or 1 lb. of sodium nitrate to 20 lb. of sulphur.

The sulphuring process is completed when the juice can be seen collecting in the cavity of the fruit. Care should be taken while transferring, so that juice collected, which is very rich in sugar, should not be lost.

After sulphuring the trays are moved to the drying yard and exposed to the sun till they become leathery and dry. Then the trays are stacked one over the other and an empty tray is placed on the top as a cover. The rest of the drying is done by air circulation through trays. As much drying should take place after stacking as possible in order to obtain a dried product of the highest quality.

Curing or sweating

When boxed or binned the individual pieces of fruit vary in moisture content. During the first three weeks the moisture is transferred from the wet to the dry pieces either by direct contact or by evaporation into the air spaces and absorption therefrom. Sweat boxes are ideal for this curing process.

For storage the conditions should be the best that can be provided. The storage space should be cool, dry and well lighted and ventilated. Storage boxes should be well cleaned and fumigated before the fruit is introduced, and may be examined now and then for insect attack.

Packing of dried fruit

Necessary precautions are to be taken in the packing of dried fruit. Insect should have no access to the fruit nor should the fruit be exposed to changing weather for it will deteriorate in quality. The modern method of packing is in cellophane packets. But packing in cardboard boxes covered with cellophane paper is equally good for ordinary purposes. After sweating, the dried fruit is washed and resulphured. Before packing, it is steamed for a minute or two. This removes dust or organisms accumulated on the fruit and helps in rapid and successful pressing of the fruit. At the time of packing the moisture content is about 17 per cent. The fruit is then pressed in an ordinary wooden-framed press. It can also be pressed in a flanging machine or a book-binding press. The pressed packet is placed in cartons of the same dimensions with the direction for use of dried fruits on one side and wrapped with cellophane paper after labelling. Thus the fruit is prepared for retail sale. For bulk sales the fruit is packed loose in bigger wooden or tea boxes.

COTTON JASSIDS AND THEIR CONTROL

By K. B. Lal, M.Sc., Ph.D. (Edin.)
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THE cotton crop in India, as in many other countries, is susceptible to the attack of a large number of insect pests which materially reduce its yield. These insects are of two kinds: (i) those that suck the juice from the leaves and other parts of the plants, and (ii) those that bite their food off the leaves, buds, bolls, etc. Among sucking insects, perhaps the most serious are the jassids, a group of small, active, yellowish-green insects that infest a variety of crops, in many cases causing severe damage. The jassids occurring on the cotton plant are known from Africa, the Philippines, Haiti, Fiji, Papua, South Carolina, Queensland and India, but are specially serious pests in East, West and South Africa and in the Punjab, Sind and Madras. Cotton jassids chiefly belong to the genus *Empoasca*, the two most important species being *E. facialis* Jac. in Africa and *E. devastans* Dist. in India.

Nature and extent of damage

Jassids are believed to cause injury to cotton plants by feeding upon them in large numbers and desapping them. This results in some characteristic symptoms the commonest of which are curling of the leaves and drying up and bronzing of certain parts of them from the periphery inwards. In cases of heavy attack, the bronzing affects the entire leaf, a condition which may sometimes be confused with the reddening of cotton leaves commonly observed in the years of failure of the cotton crops in the Punjab and Sind. The two symptoms, however, are distinct. The leaves affected by jassids are a dull brick red colour, while those associated with the failures of cotton crops, which have nothing to do with cotton jassids, are deep crimson red.

Cotton jassids, both in India and in Africa, were at one time suspected of transmitting a virus disease known as 'leaf curl' or 'leaf crinkle' of cotton. In India, however, this disease, or for the matter of that, any virus disease of the cotton plant, has not been definitely established so far; nor has there been any evidence to connect the cotton jassid with a virus disease known in this country. In certain areas, e.g. Italian Somaliland and Southern Rhodesia, where 'leaf curl' and *E. facialis* are found to be associated, it has been suggested that the curling is caused by a toxin in the saliva of the jassid injected in the course of its feeding and not by the transmission of a virus disease. In north-western India also, *E. devastans* does not always appear to cause injury to its hosts merely by feeding on them in large numbers but also by injecting injurious substances into the plant tissues. A fourth possibility has also been suggested, namely that cotton jassids (as observed in Rhodesia) are the carriers of a fungus which really causes the discolouration and injury apparently associated with their attack. This suggestion has, however, been very far from being confirmed. Whatever the exact manner of injury, the net result is a shrivelling of the whole or part of the plant, accompanied by a bronzing of its leaves, over areas infested with this insect and the consequent loss of yield.

Although no estimate is available of the actual loss caused through the cotton jassids, there is no doubt of their status as serious pests in several areas. In South Africa generally the importance of this pest is reflected in the efforts made during the last 15 years to evolve jassid-resistant varieties of cotton and in Southern Rhodesia, particularly, *E. facialis* has been long considered to be the limiting factor in the successful production of cotton. In the Philippines, another species of jassid, *Empoasca flavescens* Fabr. (the tea green-fly, well known in north-eastern

and southern India as a pest of tea), together with aphids and mites, was held responsible for the failure of an extensive cotton planting in 1926. In the Punjab the failure of 3F cotton over large areas in 1913 was generally attributed to the work of *E. devastans* and in the last 20 years the position has, if anything, steadily worsened, so much so that today a variety that is not jassid-resistant has no chance of success in the province. In Sind this pest bids fair to eclipse all others by its damage and in Madras it is one of the three or four of the major pests of cotton.

Life-history and habits

Cotton jassids, as a rule, insert their eggs into the leaf veins from which hatch very small yellowish or greenish nymphs. These nymphs attach themselves chiefly to the undersurface of the leaves, especially near the bases of the principal veins, and suck the juice till the leaves have almost withered, when they move on to the next healthy leaf. The five nymphal stages are rapidly passed, specially in warm and humid weather, and the adult emerges to feed and to lay fresh eggs. In the absence of the cotton plant, the jassids may live and breed on such alternative host plants as *bhindi* (*Hibiscus esculentus*), hollyhock (*Althaea rosea*), brinjal (*Solanum melongina*), potato (*S. tuberosum*). In north-west India the shortest life cycle of *E. devastans*, from the egg to the adult stage, may take about 12 days and during a year eleven or more generations may occur. With the change of season, the adult jassid undergoes marked changes of colouration. During summer in north-west India it is a yellowish green insect; during winter it turns to reddish brown.

Usually the cotton plant just before flowering is most heavily attacked, but this may not always be true. The time of maximum infestation, therefore, varies with different localities, depending on, among other factors, the time the cotton crop comes into the most susceptible stage. In north-west India this period generally is from July to September, while in south India it is December-January. It is also now well known that as far as India, at any rate, is concerned, indigenous varieties of cotton are not susceptible to the attack of jassids, but the greatest sufferers are the foreign varieties imported for cultivation, e.g. many of the American cottons now being grown in the Punjab and Sind and Cambodia, Bourbon and Sea Island cottons in south India.

Control

Jassids, being sucking insects, can be killed by spraying the cotton plants with rosin compound, pyrethrum or other contact insecticides or by dusting with such substances as nicotine or calcium cyanide. In Formosa sprays of pyrethrum and soap or petroleum emulsion were considered effective against the nymphs of *Empoasca biguttula*, and in Zululand a 4 per cent nicotine dust, applied by a mechanical duster, was said to kill 70 per cent of adults and 100 per cent of nymphs of *E. facialis*, but here the cost of the dust alone worked out to about 5*s*. per acre. Similarly, contact sprays with nicotine have been said to give 'very good results' against adults and nymphs both, in south India. Dusting and spraying vast areas over which cotton crops usually extend is, however, seldom a profitable undertaking. Besides, the operations have to be repeated twice or thrice to kill the newly hatched nymphs as the eggs inside the leaf veins and a fair proportion of the adults always escape destruction by the insecticide.

Destruction of the alternative host plants on which the jassids live during certain times of the year cannot be recommended as many of them are of good economic value. Even if it were possible, observations have shown that it is more than likely that the jassids, in the absence of their proper food plants, would survive on almost any green plant and multiply whenever favourable conditions returned.

Some insect predators and fungus enemies of the cotton jassids are known and in north-west India several species of spiders have been observed to prey on the nymphs and adults of *E. devastans*. These agencies are singularly ineffective in controlling the pest. No insect parasite of the cotton jassids, whether in India or outside it, appears to be known. There

is, therefore, little hope of the method of biological control succeeding in the case of these pests.

Efforts have, therefore, been largely directed towards finding out conditions under which a cotton crop would withstand or escape jassid attack and towards evolving jassid-resistant varieties. In regard to the former, a perusal of the literature on the subject discloses a medley of conflicting opinions as to the factors which produce jassid resistance or susceptibility in a plant. Thus in French Sudan, cotton grown on ground rich in fertilizers, especially potash, was said to resist attack by *E. facialis*. In Papua, cotton grown in potash-deficient soils was found to suffer most from the attack of jassids but at Rabaul (New Britain) where the soil showed no deficiency or only a slight one, of phosphoric acid, the damage was even more marked. Manurial treatments were found to have no apparent effect on the degree of attack by *E. facialis* in Southern Rhodesia but in Nigeria the jassid was found to be abundant on cotton planted on poor soil. It has been suggested that certain varieties apparently suffer less from infestation by jassids due to their greater adaptability to a particular environment and their resistance to drought. In Transvaal, however, according to another view, the worst attack usually occurred after heavy rains and infestation appeared to be connected with poor or waterlogged soil and not due to better adaptation to environment. Experience in north-west India seems to show that the developmental activity of *E. devastans* is greatly increased during warm and humid weather but there has been no evidence to suggest that differential manure or irrigation treatments have any marked effect on its incidence. Early sown cotton in certain parts of the Punjab has at times been found to suffer less than late sown cotton but this needs confirmation. It is difficult, therefore, to recommend cultural measures of control with any confidence.

Resistant varieties of cotton

For some time past, both in South Africa and in India, efforts have been made to evolve jassid-resistant varieties of cotton. The fact that cotton jassids show considerable varietal discrimination in their attack has been exploited to hybridize resistant varieties with those which are susceptible but otherwise possess desirable characters. Sometimes the method of selection has been employed and stray plants showing resistance in a field of heavy infestation have been isolated and multiplied. Alongside this there have been attempts to discover the factors responsible for anti-jassid resistance in the cotton plants themselves.

It has been widely believed not only in regard to cotton but also several crops such as potato, alfalfa, clover, etc., that attack on them by jassids is determined largely by the hairiness of their leaves, smooth-leaved varieties suffering more than varieties with pubescent leaves. This belief was recently put to test in the Punjab in connection with the work on *E. devastans* and the conclusion arrived at was that although all resistant varieties of cotton are usually hairy, all hairy varieties are not necessarily resistant. This was shown in the Punjab by the American variety 43F, which is one of the most hairy of American varieties, yet its resistance against jassids is sometimes, though not always, very low.

Another point that has emerged from the author's work at Lyallpur is that the resistance of a variety is due essentially to its unsuitability for egg-laying by the jassid females and not to its unpalatability as food. In other words, if it were possible to infest heavily a crop of even a very resistant variety with jassid nymphs and keep up this nymphal population for some time, the crop will succumb just as well as any other crop of a susceptible variety. This finding may well narrow down the search for anti-jassid characters in the cotton plant to its leaf veins since it is in them that eggs are mostly laid.

Future lines of work

It is more than probable that attempts at the production of jassid-resistant varieties of cotton will continue, both in South Africa and in India, though until the factors causing resistance are discovered the work must progress by the method of hit or miss. So far

workers in South Africa have been relying on the pubescence of leaves as a protective factor against jassids, but, as already stated, this factor is of very doubtful utility. A more profitable line of approach appears to be to study the physical and chemical characteristics of the leaf veins in the resistant and susceptible varieties and find out what exactly it is that makes some veins unsuitable for egg-laying by jassids. Alongside this the effect of such environmental factors as temperature, rainfall, presence or absence of host plants other than cotton, which undoubtedly influence jassid multiplication, should be studied. The seasonal population of jassids on cotton and other host plants and the causes of their fluctuation not only from season to season but also from year to year should also be investigated. A cotton variety that will combine jassid-resistance with other desirable characters, sown during periods which may enable the plant later to dodge the infestations of the pest, when they may develop and grow in a soil so controlled by suitable irrigation and manuring that it will produce sap in the plant of a kind which will not encourage the development of jassid colonies on it, may prove to be the ideal solution of the jassid problem. It is possible that some of the recommendations may involve the adoption of measures which may also be found useful for cultural practices.

LABLAB—THE GARDEN BEAN

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DOLICHOS LABLAB, a member of the same genus as *kulthi*, the common horsegram (*Dolichos biflorus*), is a bean distributed throughout the tropical and temperate regions of Asia, Africa and America. Its original home is India and it has been under cultivation perhaps for the past three thousand years. There are two varieties in this bean, the bushy field variety (fig. 1) and the twining garden variety (figs. 2 & 3). The former can be easily made out by its characteristic strong smell due to the presence of oil glands. The pods are tough, firm-walled and parchmented and unpalatable as a vegetable; their seeds alone can be made use of. The latter variety has no oily secretion and its pods are tender and edible, some of them so soft as to shrink considerably on drying.

Popularity in South India

The garden variety is *par excellence* a plant for the kitchen-garden, and throughout the tropics it is cultivated for its tender pods. In temperate climates, however, it is grown as an ornamental plant, especially the purple showy-flowered varieties. It is common in India, particularly in the central, western and southern regions and in Bengal. With the onset of the monsoon there is rarely a house in South India with any open space attached to it that does not grow this garden bean, providing the household a continuous supply of green tender pods for a few months.

Being a native of India, this bean goes under different names in the different Indian languages. In South India it is known as *avarai* (Tamil), *chikkudu* (Telugu), and *chapprada avare* (Kanarese). Its chief North Indian names are *shim* (Bengali and Hindustani) and *val* (Gujarati and Marathi). Its Sanskrit name is *shimbi*.

A delicious bean

The lablab bean is one of the most delicious of the indigenous Indian beans and its pods provide a very tasty, nutritious and cheap form of protein. Aykroyd, in *Health Bulletin No. 23,* published by the Government of India, gives the composition of this garden bean as below:

Moisture	82·4	per cent
Protein	4·5	,,
Fat (Ether extractives)	0·1	,,
Mineral matter	1·0	,,
Carbohydrate	10·0	,,
Calcium	0·05	,,
Phosphorus	0·06	,,
Iron (mg.)	1·6	,,
Calorific value (100 gm.)	59·0	
Vitamin C (mg. per 100 gm.)	12·0	

Several delicious dishes can be made with the tender pods of the garden bean. They could be prepared in conjunction with other *dals*, with or without tamarind or lime-juice. In most of the varieties the pods keep their tenderness until they attain full size but thereafter the seeds alone can be utilized. Surplus quantities of the vegetable can be easily preserved for use in the off-season. The vegetable is boiled with salt and thoroughly dried in the sun and when thus preserved easily keeps for a year. The preserved vegetable may be used in the same way as the fresh one. A favourite way of eating it is after frying in ghee or oil.

Cultivation

A large amount of personal care is bestowed on the cultivation of this vegetable. The

practice adopted in South India is as follows: A month before planting, pits are dug and exposed for aeration. The sowing time is generally July-August. Before sowing, the pits are filled up with a mixture of surface soil and farmyard manure. If the soil is poor, good red earth is often substituted. Six to ten seeds are then planted in each pit. The seeds germinate in about five days. When a month old and well established, the four healthiest vines are left and the rest thinned out. As the primary shoots begin to twine, props are put in and trellises erected for the vines to spread. The plants require copious and constant irrigation throughout their life period. Flowering generally begins from November and the pods may be gathered from the beginning of December. With care most of the varieties yield up to March and they are then removed. The vines are sometimes kept for a second season, when they begin to yield about July much earlier in the season. This is a method of securing tender pods earlier than the normal season. It has, however, the disadvantage that any insect attack present may be carried to adjacent newly sown vines of the next season.

Where grown in India

In *The Commercial Products of India* by Sir George Watt the following information is given regarding the cultivation of this bean in the various parts of India. In Bengal, different varieties are cultivated, being allowed to climb on trees or hedges. The time of sowing is June-July and green pods are obtained from January to March. It is often planted in specially prepared holes. In Assam, the bean is met with not only in the valley proper but also in the Naga, Garo, Khasia hills and Manipur. In the United Provinces, it is commonly grown along the borders of tall crops and allowed to twine itself on the plants standing on the margin. In Bombay, it comes into season from December to January. It is grown extensively in the Surat district. In South India, it is sown in gardens from June to August and reaped from October to March.

At the Millets Breeding Station, Coimbatore, plantings were made during all the twelve months of the year to see the effect of the time of sowing on the growth and yield of the garden bean. It was seen that growth, flowering and yield are affected by the time at which the seeds are sown. Sowings made from January to August produced normal plants which gave a normal yield. The January sowings, however, took 26 weeks to flower and this period gradually decreased for the succeeding sowings until the August sowings which took only 12 weeks to flower. Sowings from September to December produced poor plants. They came to flower in a shorter time and their vegetative growth was poor. Consequently the yields also were poor. It looks advisable therefore to confine the sowings to July-August.

It has been the experience at Coimbatore that this garden bean does not do well on a large community scale. It is susceptible to the attack of several pests which easily spread from plant to plant. Constant attention is hence necessary for keeping these pests away. The plants come up best when grown in the back garden and under the vigilant eye of the household.

Insect pests

The garden bean is very susceptible to insect attack. There are about a dozen of these pests of which the plant lice and the lablab bug do the greatest harm. Both suck out the juice of the plant, reducing its vitality and thereby the bearing capacity. The plant lice are small, somewhat globular insects that may be seen sticking to the tender portions of the plant in large numbers. A badly infested area has a dirty greyish appearance due to the presence of these tiny insects and their cast off skins. The attacked tissues look wilted and the leaves and pods become crinkled. This pest can be controlled by persistent spraying of the affected parts with a decoction made out of tobacco stalks. The lablab bugs are green in colour, each being about the size of a small red gram seed. They are gregarious in habit, being found in large numbers on the tender parts of the plant. Unlike the plant lice these insects fly about when disturbed. They have a characteristic disagreeable smell. They have to be handpicked and destroyed. Shaking the vines

over buckets containing kerosene oil and water at night when the insects are sluggish has been found to be the best way of controlling the pest.

Varieties

Perhaps no other vegetable shows so much variation in all its parts as the lablab bean. Its close association with man has led to the evolution of numerous forms. At Coimbatore a collection of 300 samples studied has yielded no less than 120 constant morphological types. The most important characters by which the various types can be made out are those associated with the pod itself. Types may vary for the following characters of the pod.

(1) *Size and shape.* There is a considerable extent of variation in this character. The length of the pod may vary from 5 cm. to 20 cm. and the breadth from 1 cm. to 5 cm. An idea of the range of variation in size and shape may be had from fig. 4.

(2) *Texture.* In texture the pods may vary from being nearly as fibrous as those of the field varieties to pods that are so fleshy that they wrinkle up on drying.

(3) *Taste.* The range in taste is from the slightly bitter but not disagreeable 'lablab taste' to slight sweetness. This sweetness finds an index in its greater susceptibility to the attack of ants.

(4) *Chlorophyll colour.* Varieties may be grouped into two classes, green or light green according as their pod colour is dark-green or light-green. Fig. 5 shows this difference even in the photographs of the pods. It has been found that the sweet taste of the pods is often associated with the light-green types and the bitter taste with the green. These two classes may also be distinguished by the greenness in the corresponding vegetative parts but the difference here is less marked in appearance.

(5) *Purple colour.* Varieties may be purple-pigmented or not. In the pigmented varieties three kinds of pod pigmentation have been met with—(*a*) purple all over, (*b*) purple on the edges only, (*c*) purple on the edges and a purple wash in between.

(6) *Septa in pods.* Pods may be either septate or non-septate. In the former each seed occupies a different compartment in the pod, while in the latter the septa that exist between seed and seed are absent, giving the pod a bloated appearance.

Coming to the seed, the main variations observed are in the colour of the seed-coat. When mature and dry they may be coloured black, chocolate, or khaki, these colours being present either over the whole of the seed-coat or confined to certain portions only. Variations also occur in the size and shape of the seeds and in their disposition inside the pod. The disposition may vary from the seeds being parallel to the length of the pod to being perpendicular to it.

The length of the stalk of the inflorescence in lablab varies to a considerable extent, but varieties may, however, be broadly classified as long- or short-stalked. In the long-stalked varieties the length ranges from 15 cm. to 45 cm. The flowers and pods in these are showy and may be seen well above the leaf zone. Many of these varieties, especially the purple-flowered ones, are ornamental, an attribute giving this plant its American name, the *Bonavist.* In the short-stalked varieties the stalk may vary in length from 1 cm. to 5 cm., extending in rare cases up to 10 cm. The flowers and pods in these are more or less hidden by the foliage.

As in the pods, different colour groups of purple exist in the floral and vegetative parts of the garden bean. According to the depth and distribution of the purple colour, three groups of pigmentation have been met with in the corolla and five groups in the vegetative parts. Contrasted with these are the varieties that have white corolla and no purple pigment. Close relationships exist between the purple colour of the vegetative parts, of the flowers, of the pods and of the seed-coat.

Work at Coimbatore

In the types isolated at the Millets Breeding Station from a wide collection of the South Indian varieties, work is in progress with a view to the selection of varieties that combine quality with yield. In a vegetable like the garden bean, quality of pod is more important than yield. The components of quality are good taste and absence of fibre. Being an

intensely domesticated vegetable, improved seeds often spread unnoticed, so much so that at Coimbatore many of the better varieties grown are already having a natural spread and in the local markets these are now appearing in large quantities, whereas till recently only a few local varieties used to be seen. Below are given short descriptions of half a dozen of the most economic selections made at Coimbatore (fig. 5).

D. L. 259. Plants green. Inflorescence long-stalked. Pod about 9 cm. long and 3½ cm. broad, fleshy, and having the 'lablab taste', green in colour, septate. Seed chocolate.

D. L. 250. Plants medium purple. Inflorescence long-stalked. Pod about 8 cm. long and 2 cm. broad, very fleshy, sweet to the taste, light-green in colour with purple on the edges and purple wash in between, septate. Seed black.

D. L. 692. Plants light-green. Inflorescence long-stalked. Pod about 14 cm. long and 1½ cm. broad, fleshy, sweet to the taste, light-green in colour, non-septate. Seed chocolate.

D. L. 453. Plants purple. Inflorescence long-stalked. Pod about 8 cm. long and 3 cm. broad, fleshy, sweet to the taste, purple all over, septate. Seed black.

D. L. 244. Plants light-green. Inflorescence long-stalked. Pod about 7 cm. long and 2 cm. broad, fleshy, sweet to the taste, light-green in colour, septate. Seed chocolate.

D. L. 279. Plants purple. Inflorescence long-stalked. Pod about 12 cm. long and 1½ cm. broad, fleshy, having the 'lablab taste', green in colour with purple on the edges and purple wash in between, septate. Seed black.

A new variety

The garden varieties are delicate and require individual care and copious irrigation. The field types of lablab are hardy and thrive well under dry condition, and on indifferent soils. These two varieties readily cross, but the subsequent generations are usually sterile. However, in one of the crosses made at Coimbatore, it has been possible to evolve a fertile variety that combines the quality of the pods existing in the garden variety with the hardiness of the field variety. Its pods are similar to D. L. 250 (fig. 5). Seeds of this variety, D. L. 1428, are being multiplied for distribution.

The above are some of the outstanding economic types under Coimbatore conditions. In addition to these, two dozen other varieties are being kept on to meet a wider demand. This little note will not have been written in vain, if it brings home the availability of this excellent and handy source of protein and vegetable within the reach of the poorest of our country folk.

FIG. 1. The bushy field variety

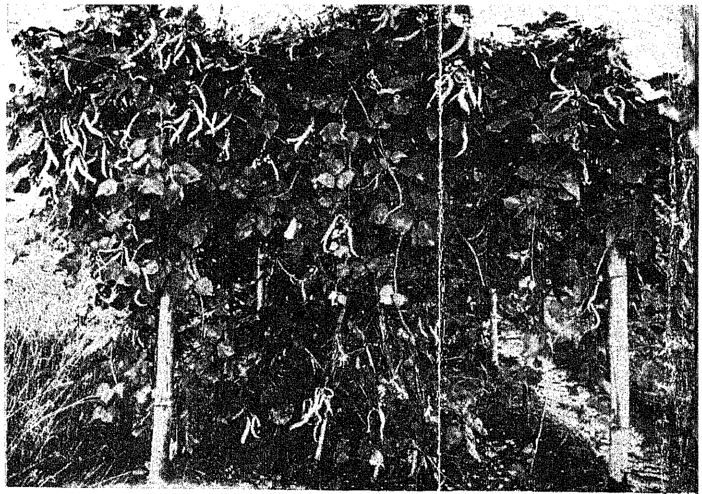


FIG. 2. The twining Garden variety

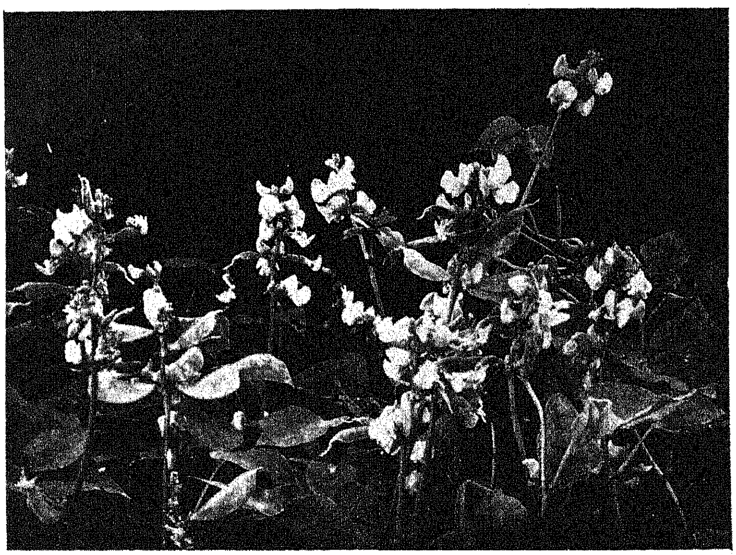
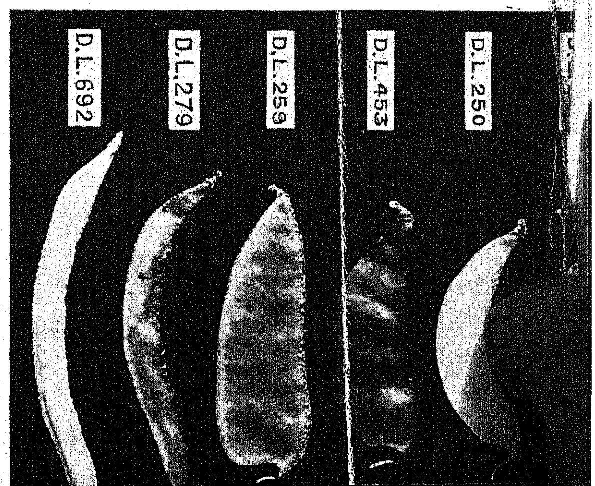


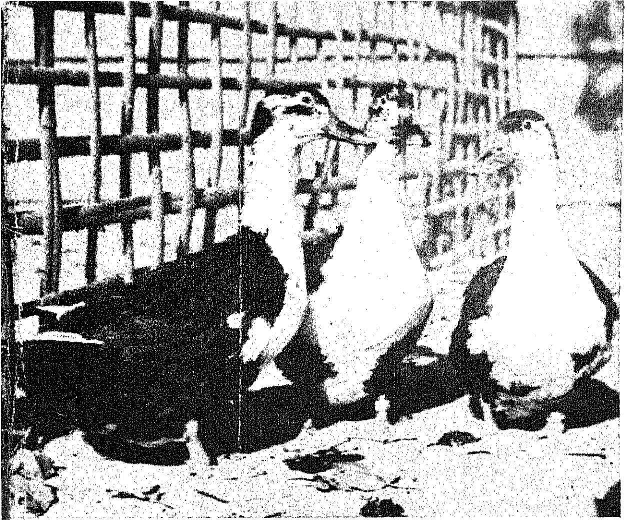
FIG. 3. Garden variety : flowers and pods

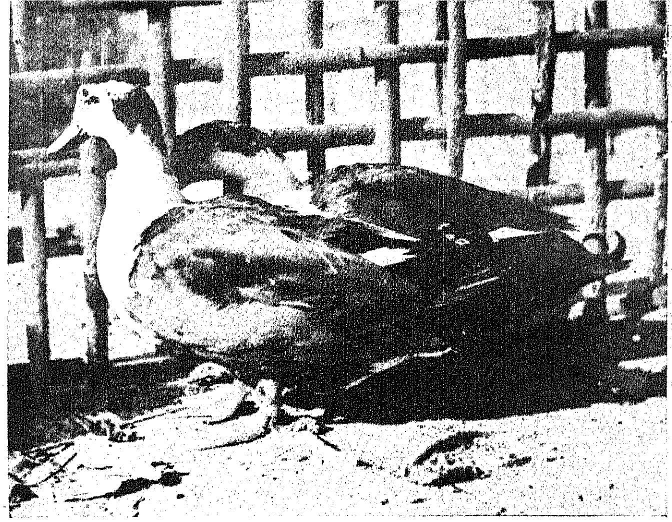
[PLATE 124

FIG. 5. Some outstanding types

FIG. 4. Pod shapes in the garden variety

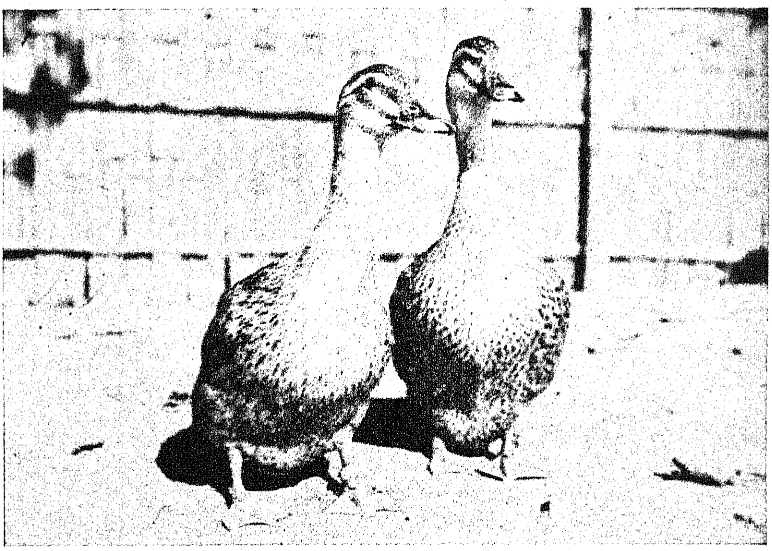






.bove : White-breasted Nageswari. Ducks

Above : White-breasted Nageswari. Drakes

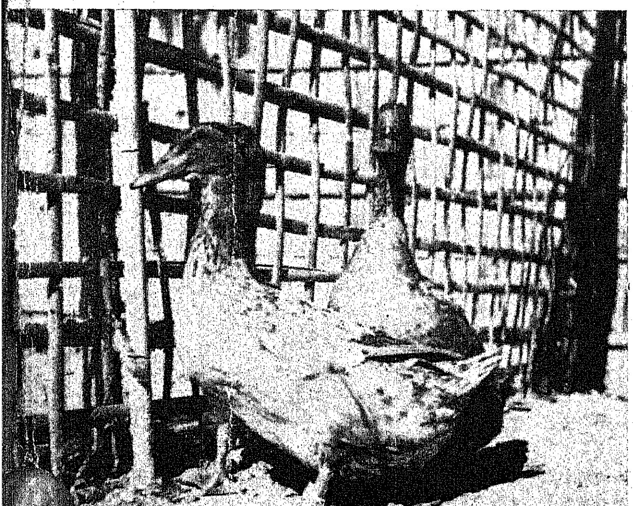


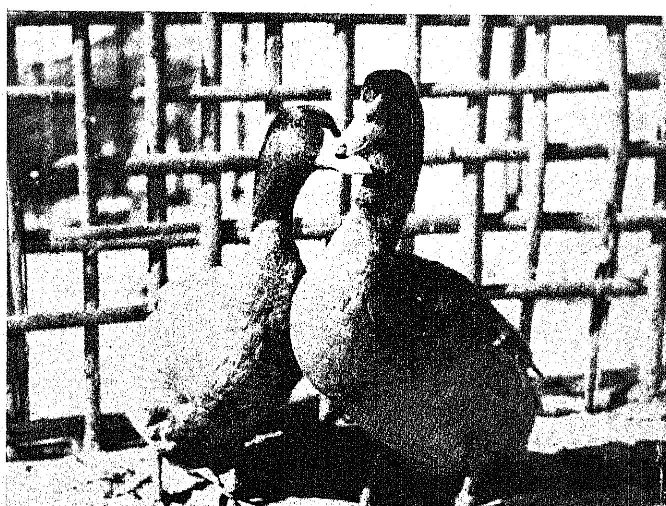
Left : Sylhet Mete : A pair

PLATE 125]

Below : Khaki Campbells Imported from England

Below : Khaki Campbells from England





POSSIBILITIES OF SIX-ANNA DUCKS

By R. C. Woodford, I.D.D.

Deputy Director of Agriculture, Livestock, Assam

THERE are possibilities, it would seem, for considerable development in the egg-laying capacity of certain types of Indian ducks, and this short note is put forward to assist the Imperial Council of Agricultural Research in its search for types of livestock worthy of attention.

There is, as might be expected, a large number of ducks in the villages of the low-lying country of the Surma Valley and in the adjoining territory of East Bengal. When these ducks were examined, two types seemed to stand out as somewhat distinct and having the ability to breed true to type. There may, of course, be other types, but we selected the two described below, and I think we made both a knowledgeable and a lucky shot.

White-breasted Nageswari

The Nageswari is the local name for a type of duck which lays a pale blue egg. Whether it ever meant more than that is hard to determine but we received suggestions that the name had something to do with snake-like markings on the beak. Amongst the Nageswari ducks is the type shown in the accompanying photograph. We named it the White-breasted Nageswari for obvious reasons. The back and most of the body is black and the breast and throat are white. These ducks are active feeders and there is little tendency to go broody. The moulting period is brief.

Sylhet Mete

The Sylhet mete is the ordinary duck of the villages, having light brown feathering with black tips. It lays a white egg and is more thickly built and shorter than the Nageswari. When in full feather the drake has a blue neck and head, as seen in the photograph. There is a slightly greater tendency to go broody than in the Nageswari, but the moulting period is just as brief.

Records

The statement below gives the records of the best egg layers which we have had under test for the past three years.

We started casting birds yielding less than 60 eggs two years ago, but we are already able to raise the minimum to 100; and of course eggs of the two 150-egg birds are specially valued. There are several first-year youngsters which promise to pass the 150 mark.

The size and weight of the birds and the size and the weight of the eggs are of course less than those of the developed breeds of Europe and America. But we have only just begun. We were not able to get more than 80 eggs per annum out of imported Khaki Campbell ducks under our conditions and we found locally born Khaki Campbells to be very delicate and difficult to rear. We have been surprised to find that less than 10 per cent of the total numbers have had to be cast for wrong colour. When I write 'we', I include Messrs B. K. Das and J. C. Chakravarty, the Agricultural Inspectors, Livestock, who did the work.

Breed	Duck No.	Best egg record April-March	Year of age in which record was made	Average weight of eggs (in oz.)	Average live weight of ducks (in lb. and oz.)	
				oz.	lb.	oz.
W. B. Nageswari	1	116	2nd year	1·84	3	5·73
Do.	2	116	3rd year	1·85	3	6
Do.	3	157	3rd year	1·93	3	7·13
Do.	4	127	2nd year	1·76	3	3·63
Do.	6	104	2nd year	1·67	3	1·53
Sylhet Mete	12	134	3rd year	1·78	3	8·1
Do.	13	133	3rd year	1·82	3	0 5
Do.	14	101	2nd year	1·68	3	6·0
Do.	15	102	2nd year	1·87	3	3 6
Do.	16	140	2nd year	1·76	3	3·9
Do.	17	103	4th year	1·79	3	3·7
Do.	21	108	4th year	1·85	3	3·8
Do.	23	155	3rd year	1·68	3	2·9

AGRICULTURAL DEVELOPMENT IN JHALAWAR

By Kunwar Narain Singh Mathur

Chief Revenue Officer and Director of Agriculture, Jhalawar State (Rajputana)

HAVING been a student of rural economics at Oxford, His Highness of Jhalawar is keenly interested in rural reconstruction and in running a model farm of about 400 acres under his personal supervision. Here research is undertaken to find out varieties of seeds and operations suited to the soil, climate and needs of the state as well as to demonstrate improved methods of horticulture, goat-keeping, dairying and poultry.

To give an impetus to agricultural development, His Highness secured the services of an agricultural expert from the United Provinces Government in 1935. After studying local conditions and practices, the expert chalked out definite lines of experimental, demonstration and propaganda work.

Experiment and demonstration

An experimental farm was started to try improved varieties of seeds, efficient methods of cultivation, rotation of crops, *gur*- and compost-making, and other techniques in comparison with indigenous methods with a view to establishing the superiority of the former. The results were demonstrated in the cultivators' fields under departmental supervision.

Introduction of improvements in conservative villages is difficult. The only way to convince the cultivator of the efficiency of new methods is demonstration in his own fields. The better results obtained by improved seeds and methods in comparison with the local ones in the same field convince the owner of the efficiency of our recommendations which are readily adopted by other villagers also, and the demonstration plot becomes the nucleus for development in that area.

Rural shows

For agricultural propaganda, shows were arranged at cattle fairs and prizes were given to the cultivators for exhibits of crops and cattle. During his tours the Director of Agriculture collected the cultivators in his camp and explained the advantages of improved methods of cultivation, sanitation, co-operation and education, and improved implements were also demonstrated in their fields.

Systematic work was started from the *kharif* season of 1936. The methods adopted to obtain varieties which are superior to local ones both as regards quality and yield were selection and acclimatization.

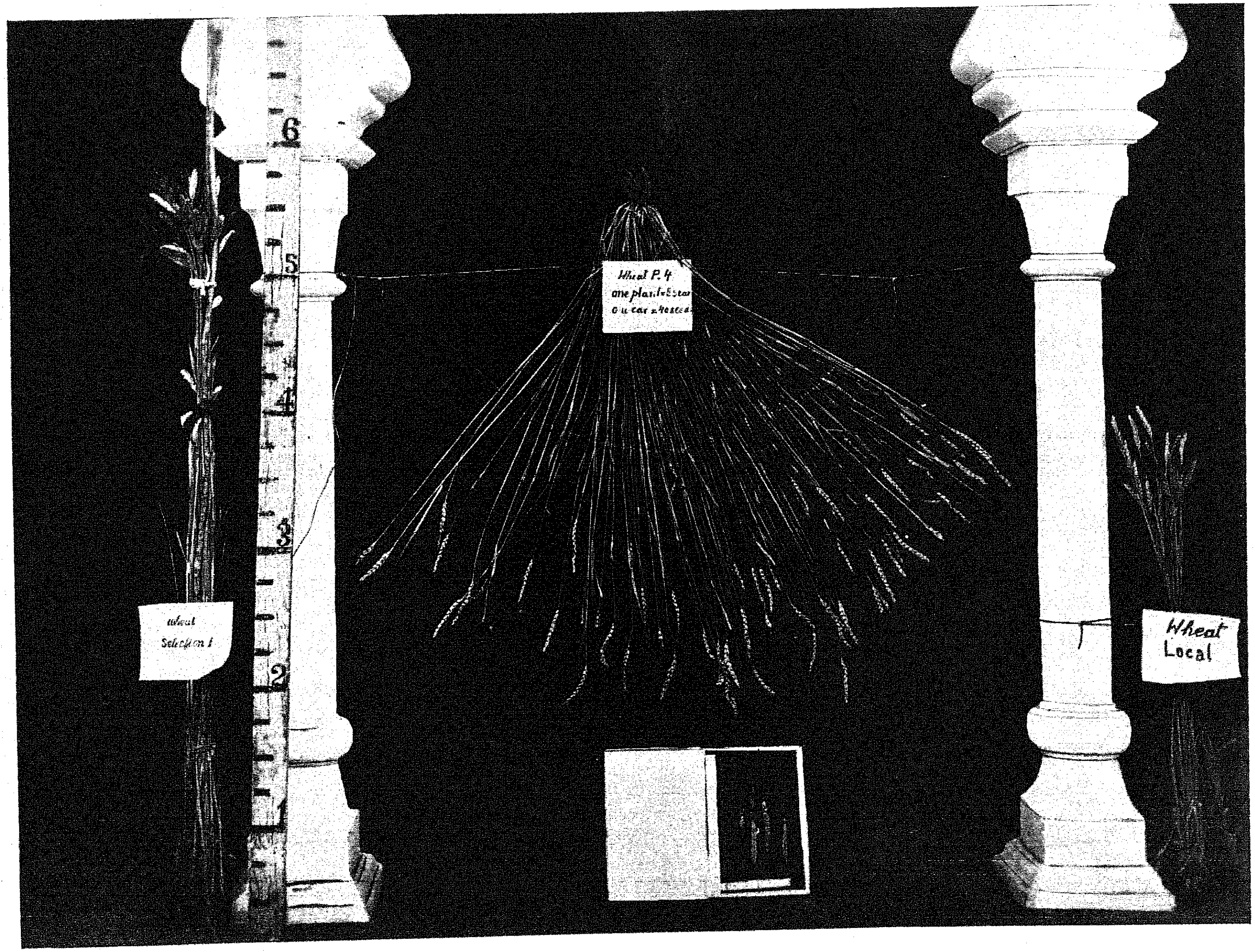
Sugarcane research

Co 213, Co 290, Co 312, 591, POJ2878 and Saharanpuri sugarcanes were tried with local varieties. Co 290 gave the best yield, both as regards quantity of canes and quality of *gur*. This variety is spreading rapidly. January and February were found to be the best months for sowing sugarcane. The problem before the Department was not only to replace the local variety with a better one but also to increase the area under this valuable crop to feed an open-pan sugar factory which has been started this year. Intensive propaganda has doubled the area and sufficient supply for the factory is assured.

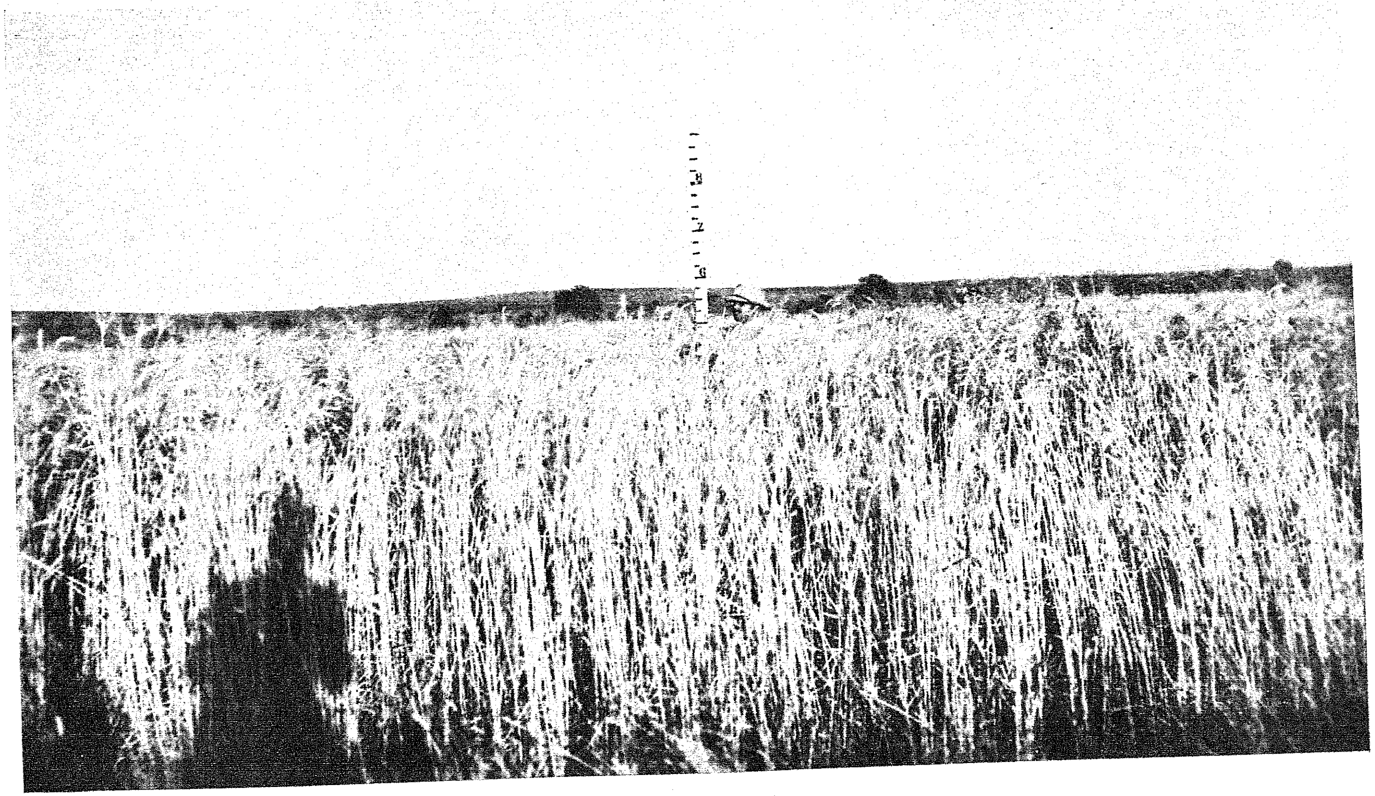
C402, C520, G16, V438, Combodia and Malvi 9 cotton were tried with the local selections. C520 has given the best yield and 72 md. of this seed has been sown in a compact area. Local selections of Malvi cotton were sown in the districts.

A dozen improved varieties of U. P. *arhar* were tried with the local seeds. Imported varieties had big bushy plants and profuse flowering. Unfortunately, repeated attacks of severe frost damaged the crop completely.

No. 11/10, 4/3, 16/15, African, Giant Jamnagar and local varieties of *bajra* were under trial. Giant Jamnagar is a big-seeded variety



Ears of Wheat — Local *v.* selection No. 1. One plant of IP 4 wheat which gave 83 ears



A field of wheat selection No. 1 on green manure of *sanai*
(Salotia Demonstration Farm, Jhalawar State)

and has produced an ear of corn measuring 4 ft. 2 in., but the conclusive result about yield has not yet been reached.

Palwan, Mushkan, S. No. 1., S. No. 21, and local varieties of paddy were tried. S. No. 1 has given the best yield and is popular because it is a long, thin-seeded variety and matures early.

Experiments on *ganja* cultivation were carried out under the supervision of an expert who has been called from Kathiawar. *Ganja*, *bhang* and *charas*, which are valuable intoxicating drugs, are prepared from this plant.

Groundnut

Groundnut is a crop of economic importance and, being a leguminous one, improves the fertility of the soil and is in great demand in the local oil mill. Big Japanese, Small Spanish, A K 12-21, A K 8-11, Akola 10 were tried with the local varieties. Akola 10 gave the highest yield. Trials were continued to find out the heaviest yielding variety with high oil percentage and possessing the quality of upright bunched type which is easier and cheaper to harvest.

Many varieties of wheat were imported for irrigated as well as dry tracts and were tried on the farm with the local selections. Punjab 8A for the irrigated fields and GD11 for the unirrigated fields were found to be the best.

Hill potatoes and *phulwa* of Farrukhabad were tried on the farm. The crop being damaged by frost, conclusive results could not be obtained.

IP25, Sharbati, Kabuli and local varieties of gram were tried, IP25 has given the highest yield.

Oil mill

An oil mill was opened at the beginning of 1940. To feed it with oilseeds of high oil percentage, ten improved varieties of mustard and safflower received from the Economic Botanist to the United Provinces Government were tried. The produce of the promising strains has been stored and will be sown in bigger areas with a view to making selections of the best variety.

To improve the quality and to increase the supply of green fodder during summer many fodder crops were tried. As a result a demand for lucerne seed has been created.

A Government seed depot has been opened for the supply of improved seeds and implements. The seeds were issued to cultivators on the *sawai bari* system and *taccavi* loans were advanced on joint responsibility. Facilities for realization are provided to the private agencies who undertake the supply of improved seeds. Four such depots are supplying selected Malvi cotton seed.

Kirloskar's turn-wrest plough for the heavy soils and Kon-kon plough for the light soils are recommended. The Karamat Cane Crusher gave higher extraction up to 71 per cent and greater output than the local crushers and is gaining in popularity. Circular chaff cutter, hand maize sheller, disc and lever harrows, Duffen and Teffun seed drills and Persian wheels are yet under trial.

The advantages of green manuring with sunn-hemp and compost-making and growing leguminous crops were explained and demonstrated and the application of castor-cake to the sugarcane crop was recommended.

Dry farming

Cultivators in dry tracts which, unfortunately, occupy about 91 per cent of the cultivated area entirely depend upon the vagaries of the monsoon. To improve their lot simple principles of dry farming, which involve no expenditure, were explained to the cultivators. They are induced to plough up fallow lands soon after the winter rains to expose the sub-soil to weathering agencies and to get rid of weeds and fissures which dry up the lower layers of the soil.

It was found that the cultivators gave too many waterings to the crops which produced foliage growth at the cost of seed, spoiled physical, chemical and biological properties of the soil and the crop suffered from diseases like rust, and consequently the irrigated area was less than what could be commanded by the existing source of irrigation. A judicious use of well water was successfully demonstrated on the farm by maturing wheat and sugarcane crops on half the number of waterings which the local cultivators used to give to the crops. The practice when generally

adopted would not only increase the yield but the well water thus saved could be utilized in irrigating a larger area.

Soil erosion causes infertility. The cultivators were ignorant of this slow and steady process of loss. It was pointed out to them that the levelling and the *bunding* of such fields and the planting of perennial grasses which held the soil and covered the surface with a mat of vegetation could profitably be adopted as remedial measures.

To safeguard the cotton crop against the damage of the pink bollworm, the sun-drying of cotton seed before sowing was tried and the advantages of this simple, inexpensive and highly effective remedy were explained to the seed suppliers and cotton growers. Too many waterings to wheat during cloudy weather caused rust which damaged the crop completely. The growing of disease-resisting varieties on a judicious supply of water and proper spacing was recommended.

Cactus bushes which occupied rich *gohani* lands and harboured snakes and harmful birds and insects were destroyed by the introduction of the cochineal insect.

Land colonization

Thousands of *bighas* of rich land is lying fallow for want of tillers. The colonization of such lands is being tried in two districts. An agent is appointed to invite outsiders for whom special concessions are granted. It is too early to estimate the success of the scheme as the rent-free period is not over yet.

One of the new settlers has been experimenting on tung tree cultivation for the production of tung oil which is used for industrial purposes. The seedlings have been transplanted from the nursery and are developing satisfactorily in the field.

On the basic principle that wherever there is cellular activity, electrical energy is developed and conversely, wherever electrical energy is applied, cellular activity is increased and better growth is obtained experiments on electroculture were undertaken. Mature trees which were not bearing fruit as well as young fruit plants which had completely shed their leaves during a long journey were energized by means of an old motor magneto. Young plants which appeared almost completely dead gave forth new shoots though mature trees did not respond to the treatment. In the majority of cases the experiment was successful, but the utility of the process has not yet been thoroughly established.

Cattle breeding

Cattle being the main power and wealth of the cultivators, great stress was laid upon the improvement of the local breed, which has deteriorated for lack of pasture lands and pedigree bulls. To induce the cultivators to grow better fodder crops more abundantly the land rent was reduced by 25 per cent where fodder crops were grown and the receipts of cattle-ponds were earmarked for the purchase of the pure Malvi bulls which will be supplied free to the cattle improvement zones where scrub bulls will be castrated. Facilities for veterinary services were also provided.

Since agricultural development can best be carried on by patwaris and village schoolmasters, a class was opened during the summer vacation in which 14 candidates successfully completed a short course in the theory and practice of improved farming. A scheme has been launched to train on the farm three paid apprentices. These trained candidates have been recommended for recruitment as patwaris and village schoolmasters.

Agricultural education

One of the local candidates who had passed the B. Sc. (Ag.) from the Allahabad University was sent to Mysore and Bangalore for training in forestry. He was also sent to England where he took the N. D. D. from the University of Reading. Two candidates passed the Intermediate in agriculture and one has passed a two-year course at the Agricultural School, Bulandshahr. One candidate is studying in the final year B.Sc. (Ag.) at the Cawnpore College.

To improve the quality of fruits and vegetables arrangements for the supply of plants and seeds of well-known varieties were made from certain reliable firms and nurseries of India as well as from Arthur Yates of Sydney. A dose of one pound crushed bone with half

pound castor-cake was recommended for young fruit-plants. The application produced vigorous growth in citrus and mango seedlings.

Literature distributed

To stimulate general interest in the work of the Department, agricultural magazines were supplied at concession rates and pamphlets in Indian languages containing useful information were distributed free.

Instruction about seasonal operations was given through the Revenue staff and was also published in the State Gazette.

To keep the villages clean the cultivators were advised to dig manure pits away from their houses and washing and bathing in drinking wells was prohibited.

A museum is maintained at the Revenue Office where cultivators from all the districts often come on business. Samples of the staple crops of the state, improved as well as local varieties, are exhibited and explained to the visitors. Crop exhibits sent to the Lucknow Exhibition in 1936 were awarded special certificates of merit.

Loans on nominal interest are given to the cultivators for purchase of seeds, implements and bullocks as well as for sinking of wells.

Remissions in land rent were granted when crops were damaged by the inclemency of the weather. Costly implements were supplied to the cultivators on the hire-purchase system.

What the Scientists are doing

NUTRITION OF CHICKENS

THOUGH there is very little accurate information concerning rearing results obtained under typical Indian conditions, it is well known that mortality is excessively high and that the rate of growth is very much lower than that recorded from other countries where poultry farming is a more specialized occupation. One of the main reasons for these poor rearing results is the feeding of insufficient food or food deficient in the materials for normal growth. Cereals, which form the major bulk of poultry rations, are always deficient both in the quality and quantity of their proteins, as well as in certain vitamins and minerals. In *The Indian Journal of Veterinary Science and Animal Husbandry* (Vol. XI, Part 3) A. J. Macdonald gives particulars of five nutritional experiments carried out at the Poultry Research Section, Imperial Veterinary Research Institute, Izatnagar, with the object of finding out suitable supplements to ordinary cereal diets.

Rations given

In all these experiments, the birds were fed on mash and grain rations supplemented with liberal amounts of broken limestone and fresh green food. The basal mash consisted of 50 parts wheat bran, 30 parts yellow maize meal and 20 parts ground oats. The mash was fed dry in hoppers and the birds were allowed access to these at all times. During the first eight weeks, the birds were fed on a grain mixture containing equal parts of broken yellow maize, *cheena* and *jowar*. From eight weeks onward, the grain mixture consisted of equal parts of broken yellow maize, wheat and paddy. The chickens were weighed individually at weekly or fortnightly intervals from day-old onward and a record was kept of mortality, food consumption and egg production until the end of the experiments.

In experiment I, 50 per cent of the birds (Group 1) were fed on the basal ration described above along with separated milk only to drink from day-old to 10 weeks and separated milk and water in separate containers from 10 to 24 weeks. Group 2, containing the other 50 per cent of the chicks, was fed the same rations except that water was fed instead of the separated milk during the early part of the experiment; in the latter part, owing to an excessively high mortality, it was found necessary to feed milk and water, as in the case of Group 1, from 10 to 24 weeks.

Group 1 grew normally throughout and the recorded rate of growth compared favourably with that given by various workers in other countries. The mortality of 4·8 per cent was very low and the first egg was produced at 137 days. The birds in Group 2 (reared on cereals and water to drink) grew very slowly, the mortality of 61·9 per cent was high and would have been higher if the birds had not been given supplements of separated milk at certain stages. The age at first egg was greater and the average egg production for the whole group was much lower for the 24 weeks than in Group 1.

In experiment II, Group 3 was fed on the same rations as Group 1, but Group 4 was given separated milk and water in separate containers from day-old until the end of the experiment. The feeding of the separated milk and water from day-old onwards did not give as good growth results during the early stages of growth as the separated milk only ration, and the mortality of 25·9 per cent compared very unfavourably with the 9·3 per cent recorded in Group 3. At the end of 24 weeks, the birds in both groups were very similar in weight, but the egg production was lower in the group fed the separated milk and water from day-old onward. Though the birds in Group 4 drank less milk during the early stages of the experiment, there was no saving in feeding costs over the whole period of 24 weeks, for in the later stages they drank more milk than those in Group 3.

In experiment III, Group 5 was fed the basal rations plus separated milk only to drink from

0 to 6 weeks and separated milk and water from 6 weeks onward. Group 6 was fed the basal mash plus 18 per cent common salt. The rate of growth in Group 5 was better at all stages, the mortality was lower (9·4 per cent against 16·7 per cent) and the egg production higher than that for the birds fed on the soya bean meal and salt ration.

In experiment IV, all the birds were fed on the cereal plus separated milk diet up to 6 weeks, but, from 6 weeks to the end of the experiment, 50 per cent of these birds (Group 7) were given separated milk and water to drink and the remaining birds (Group 1) were fed on the basal mash plus 18 per cent soya bean meal plus 0·5 per cent common salt. The results obtained with the soya bean meal plus salt ration from 6 to 24 weeks, though not so good as those obtained with the separated milk and water, were considered sufficiently good to warrant a further trial along these lines.

In experiment V, the birds were again fed on cereals plus separated milk only to drink from day-old to 6 weeks and then divided up into two groups as was done in experiment IV. In this experiment, which terminated at 20 weeks, the birds given separated milk and water to drink from 6 weeks onward grew more quickly, had a better health record, a slightly lower mortality rate and came into production earlier than the birds fed on the mash supplemented with soya bean meal plus salt.

Conclusions

From the results of these experiments the following conclusions were drawn :

(1) A ration of mixed cereals plus adequate amounts of calcium and green food is totally inadequate for young chickens kept under semi-intensive conditions.

(2) During the early stages of growth (day-old to 6 weeks) very good results can be obtained by supplementing this ration with separated milk only to drink.

(3) The replacement of milk only to drink with separated milk and water from day-old to 6 weeks is not advantageous, as it does not reduce the cost of rearing over the whole growth period and gives results inferior to those obtained from feeding milk only to drink during the early stages of growth.

(4) The feeding of separated milk and water in separate containers from 6 to 24 weeks gives very satisfactory results as judged by the rate of growth, general health and rate of sexual maturity.

(5) During the early stages of growth separated milk is a better supplement than soya bean meal and salt, but where separated milk is not available or very costly, fairly satisfactory results can be obtained by the use of soya bean meal and salt.

(6) From 6 weeks onwards, milk and water give better results than soya bean and salt, but, on grounds of economy, it might be better to use soya bean meal plus salt whenever milk is not easily obtainable or its cost high.

(7) Where separated milk is not obtainable similar results can be obtained with butter-milk.

(8) The level of protein necessary in chick rations when milk is fed liberally is considerably lower than the published standards.

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JUTE SPINNING TRIALS

THE spinning trial results obtained in the Technological Research Laboratories of the Indian Central Jute Committee on the 1940 crop agricultural samples received from the Dacca laboratories give further cause for encouragement. In nine separate experiments, for example, it was found that fibre from jute grown at 4 in. × 4 in. spacing was consistently superior to that at 6 in. × 6 in. spacing and this in turn was consistently superior to 9 in. × 9 in. spacing.

We now have data for six varieties of jute (three *Olitorius* and three *Capsularies*) grown in 1938, 1939 and 1940. The superior quality of the Fanduk variety is evident from the results. It is unfortunate that this is a poor yielder (compare Indian Central Jute Committee Bulletin III, 12, p. 770, March, 1941). It is realized, however, that there may be some correlation between yield per acre and fibre quality.

From the results of physical fibre measurements it is now possible to predict the strength

of yarn that may be spun from a sample of fibre with an error not exceeding 10 per cent in 85 cases out of 100, or with an error not exceeding 15 per cent in 99 cases out of 100. Work is being done to see if this can be improved upon.

The practical man has in the past often held the opinion that good spinning quality in jute is associated with a high degree of natural 'oiliness'. Results for the fat and wax content of nearly 50 samples of jute of a wide range of qualities show that in general low spinning quality is associated with a high fat and wax content (as estimated by extraction with an alcohol-benzene mixture). There is in fact quite a high negative 'correlation' between spinning quality and fat and wax content.

It has been shown that the dark grey colour of some qualities of jute (especially *Olitorius* jute) is due to the interaction between tannins in the plant and iron compounds in the retting water. A kind of 'ink' is produced on the fibre.

What would you like to know ?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q : Recently treatment of molasses and press cake as a manure to the sugarcane crop has been advocated by the Government Agriculture Department and tests have been carried out at some Government sugarcane farms. Would you kindly let us know how and in what proportion we should apply molasses and press cake per acre for sandy soil and what results by way of increase in yield, in recovery percentage of sugar we can expect therefrom and also where we can find the literature where this subject has been dealt with in detail ?

A : Experiments carried out at various centres in India on the use of molasses as manure lead to the following conclusion: 'The substance possesses excellent manurial value but its high carbohydrate content and the very wide carbon/nitrogen ratio, its liquid nature, the difficulties in transport and handling, and the inconvenient and costly methods of application are all against the use of molasses, as it is, for manurial purposes.'

Dr H. D. Sen of the Imperial Institute of Sugar Technology has overcome the above difficulties by evolving a biochemical process by which molasses has been converted into a sludge, possessing good manurial value, which is dried and sent to the farms in bags. The yield of sludge, obtained by the fermentation of molasses, or molasses and filter-press cake, using pure yeast with intermittent addition of lime or soda to neutralize the acidity, is about 40 per cent on the weight of molasses and filter-press cake (calculated on dry basis) and the cost of manufacture comes to 12 as. per maund, giving a return of 4 as. per maund of molasses and 6 pies per maund of filter-press cake.

The usual dose of this concentrated manure is 75 to 150 maunds per acre. The average yield of cane when using this manure was found to be about 1,000 maunds per acre as compared with 693·0 maunds in control and 933 maunds in the case of direct application of molasses in heavy doses (600 maunds per acre). The total sucrose in cane varies from 11·07 to 12·22 per cent as compared with the control 12·47 per cent and heavy dressing of molasses 10·56 per cent.

For further details reference may be made to *The Indian Journal of Agricultural Science*, Vol. X, Part II, April 1940, pp. 172-91.

A very effective method of utilizing press cake for manurial purposes has been evolved by Messrs R. C. Srivastava, H. S. Chaturvedi and K. Aswath Narain Rao of the Imperial Institute of Sugar Technology.

Press cake is composted with other waste materials of the cane sugar factory in order to convert the organic matter into a form in which it can be readily assimilated by the crop. The easily available waste product is cane trash or in some cases bagasse. In most of the factories cane is supplied in bullock carts and cattle urine and cowdung slurry will be useful as activators. In addition dilute molasses and effluent sludge can be used for the same purpose. The use of press mud mixed with other waste materials enables the other waste products to be utilized and also gives an increased yield of manure containing larger quantities of humus.

For further details, reference may be made to the Proceedings of the 9th Annual Convention of the Sugar Technologists' Association of India, 1940, pp. 271-92.

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* *

Q : Kindly let me know the results of researches on *Wallago attu* (*Boalis* or Freshwater shark).

I remember to have read somewhere that vitamin D has been discovered in this fish which is so abundant and at the same time neglected in our part of the country.

A : In the May issue of *Science and Culture* (Vol. VI, No. 11, p. 662, 1941) a short note was published on 'vitamin A from Fish Liver Oils' and *inter alia* it was stated therein that :

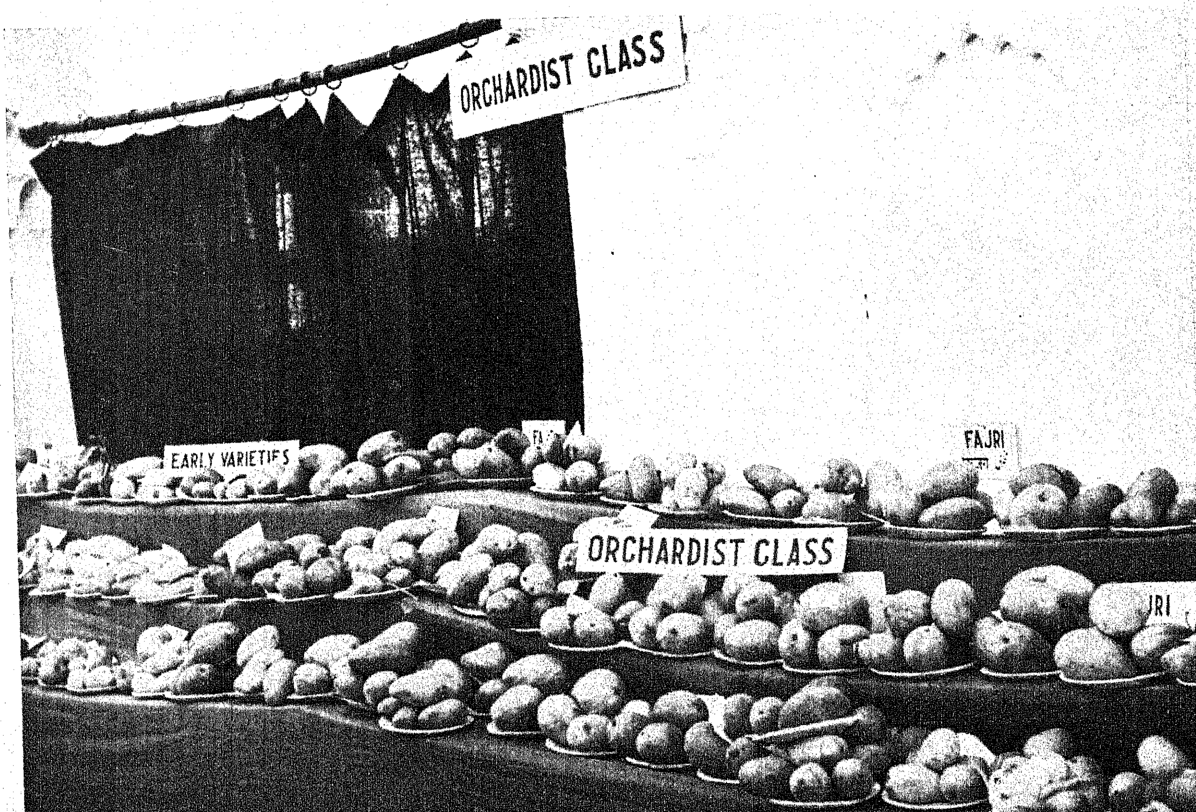
'It has been found that *air* and *boal* fish liver oil have a vitamin A content nearly half of that in halibut liver oil, while that of certain samples of *dhain* and *shole* liver oils is nearly equal that of halibut oil.'

Perhaps you are aware of the fact that halibut liver oil is the richest liver oil so far known. The *boal* liver oil is 25 times more potent than cod liver oil which is commonly used for vitamin A deficiencies. For detailed work on *boal*, reference may be made to P. K. Seshan's article 'Vitamin A content of liver and deposit fats of some Indian fish' (*Ind. Journ. Med. Res.* XXVII, pp. 711-20, 1940). You will also find a brief account in the Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1938, pp. 39-40. No reference to vitamin D contents of this fish can be traced.

U. P. Mango Show : Exhibits of the fruit product class—Members of the judging committee

[PLATE 12

Mango exhibits of the orchardist class



Exhibits of the Tenants class, chiefly jack-fruits and vegetables

[PLATE 129

Prize distribution ceremony

What's doing in All-India

UNITED PROVINCES MANGO SHOW

By JOHN A. MANAWWAR

Provincial Marketing Officer, United Provinces, and Honorary Secretary, United Provinces Fruit Development Board, Lucknow

AS a result of the success achieved last year, it was decided to make the provincial mango show an annual feature of the activities of the United Provinces Fruit Development Board. Though the show is primarily meant for magoes, the mango being the chief fruit crop of the province at this time of the year, other fruits and vegetables were also included.

As last year, the mango show was organized by the U. P. Fruit Development Board in cooperation with the Agricultural and other development departments under the patronage of His Excellency the Governor, and was financed by these departments and public donations. It was held from the 12th to the 14th July in the beautiful Baradari Hall of the British Indian Association, situated in the heart of the city and set off by picturesque gardens and old Moghul buildings. On the platform under a huge *shamiana* a model orchard was laid out to show the methods of planting different kinds of trees, proper methods of irrigation and layout of channels, roads, etc.

Class for orchardists

The hall was divided into Exhibit, Demonstration, Commercial and Nursery Stock courts. The Exhibit court occupied the central part of the hall and was divided into sections for orchardists, Government and State gardens and nurserymen, Hill Fruits, Tenants and Fruit Products. An important change this year was that a separate class was provided for orchardists as it was not considered fair to include them with the Government and State gardens and nurserymen.

In the Orchardist class mid-season and late varieties of mangoes occupied most space. Besides the well-known varieties *Langra, Dasehri, Safeda, Fajri* and *Khajri*, some excellent varieties of *desi* mangoes were exhibited. The competition in this class was so keen that additional space had to be provided. In the Tenants class jack fruits were most prominent. These were of enormous sizes—one of them was over a maund in weight.

A special feature this year was the large number of exhibits in the Hill class. Besides apples, peaches, pears and plums were also exhibited.

A number of orchardists of the Kumaun hills put up a display of the produce of their orchards in the centre of the hall, which enhanced the beauty of this court.

The Fruit Products class was extraordinarily well represented by the factories in the United Provinces, Punjab, Madras and Bengal. Prominent among these were the G. G. Fruit Preserving Factory, Agra, the Glacier Products, Ltd., Pathankot, and the Daurala Sugar Works. The Home-made section of *achars*, chutneys, jams, etc. was also well contested. Special mention is to be made of the display of different varieties of mangoes in a glass case by the Rampur Durbar and of pineapples by Berther Pinery, Assam.

Competition for local ladies

In the Demonstration court, demonstrations and lectures were arranged by the various sections of the Agricultural Department, *Gur* Development Section, the Botanical Department of the Lucknow University and the U. P. Fruit Development Board. Large crowds attended these demonstrations. Demonstration of Agmark fruit-grading and fruit preservation and canning received special

attention. A competition of *achar*, jam and chutney making was also held on the 13th for a number of local ladies.

The Commercial court provided refreshments and fruits. Messrs Arora and Co, the Co-operative Fruit Sale Society, Malihabad, and Mushtaq Gardens, Rahimabad, Lucknow district, did good business in squashes, juices, *achars*, chutneys and mangoes.

In the Nursery Stock court, grafts and plants were displayed by various Government Gardens, registered nurseries of the Board and other nurserymen in the province. Methods of packing plants and fruits were also shown in this court.

Importance of grading

The exhibits were judged on the morning of the 12th July after which the show was declared open by Mr C. Maya Das, I.A.S., President, U. P. Fruit Development Board and Director of Agriculture. The prize distribution took place on the 14th. The function was presided over by Mr P. W. Marsh, C.S.I., C.I.E., I.C.S., Adviser to His Excellency the Governor, and prizes were given away by Lady Thomas, wife of the Chief Judge, Oudh Chief Court, Lucknow.

In his opening speech, Mr C. Maya Das referred to some of the urgent needs of the Board, the most important of which was funds for a central nursery. Prizes were given away by Lady Thomas. There were 230 prizes, consisting of cups for orchardists, nurserymen, fruit preservation factories, etc. and brass utensils for the Tenants class. The running shield went again to Rao Qurban Ali Sahib, Proprietor, Henbane Nursery, Saharanpur, for the second year in succession as he won the largest number of prizes.

In his presidential address, Mr P. W. Marsh emphasized the need for utilizing the fruit resources of the country and the importance of proper grading, packing and speedy transport of fruits.

The Lucknow Police band entertained the visitors. There were over 1,500 entries for the show from about 30 districts in the province. It is estimated that about 1,500 visitors came to the show on the first day and this number gradually rose to 4,000 on the last day.

BIHAR

By B. P. Akhaury, B.Sc. (Wales)
Deputy Director of Agriculture, Patna

MARCH and April, as usual, were dry, but the west wind started a month earlier. There was rain in May which was helpful in restoring to some extent the soil moisture which had been reduced to a dangerously low state.

Tobacco suffered severely this season from leaf-curl. Potatoes were also affected due to lack of soil moisture which could not maintain the water level in the wells for irrigation. Chillies could be taken as fair. The yield of paddy was not as good as it was last year. The low price of jute and the comparatively high price of paddy caused a setback in the cultivation of jute and the area put under jute during the season is about 20 to 30 per cent below the normal.

Owing to the weak monsoon and complete failure of *hathia* rain in 1940, the *rabi* crops were not satisfactory and they matured well in advance of the normal ripening season. The quality of grain was also adversely affected by the early west wind.

This year's yield of all *rabi* crops is estimated at 84 per cent of the ten years' average according to the forecast for 1940-41.

The total yield of summer rice is estimated at 71,900 cwt. against 78,100 cwt. of last year. The forecast estimates a slight increase in other important *rabi* crops such as barley, gram, tobacco, etc. over last year's yield.

The total area sown to *rabi* crops is estimated to be 6,290,100 acres as compared to 6,209,900 acres the previous year.

Rice section

The statistical significance of all the experiments and trials conducted during the last cropping season has been worked out and the following conclusions from the more important experiments have been drawn:

Among the old introductions of paddy selections, selections 115 BK, 164-17, 141 in early group, 16 BK, 88 BK, 250-1 in the medium and 36 BK, 76 BK and 498 in the late group have again shown their superiority to the standards, Dahia, Kanke II and Latisal respectively at a number of departmental farms under diverse soil and climatic conditions; whereas the new introductions, namely 477, 69, 141-1, 488, 970, 479, 59, 890, 51, etc., paddy selection including strains of early, medium and late classes have proved superior to the standards, Dahia, Kanke II and Latisal respectively giving 15-20 per cent higher yield in grain.

A number of flood-resisting varieties tried with a view to meeting the demand of North Bihar cultivators for flooded areas have shown their superiority over the common red coarse-grained variety of paddy which the cultivators at present use.

From the results of the complex cultural experiment 25 design, it is evident that normal sown seedlings, 2 to 3 per hole, with 6 in. spacing, planted by the first week of August give better and economical results.

Among the manurial experiments, the utility of applying green manures like *dhaincha* and sunn-hemp to the paddy field has again been established, and it has been found that the application of such manures has beneficial effects and is highly economical.

Sugarcane

The red-rot epidemic of 1939-40 has been a blessing in disguise in that during the current year the area under Co 313, the variety resistant so far, has increased considerably. In certain factory areas, this variety has contributed nearly 70 per cent of the crush. This has not only reduced the extent of the disease but has also helped the factories that developed their areas in previous years to register recoveries never before reached by the sugar mills in North Bihar. The Chanpatia Sugar Factory in Champaran district, for instance, had a recovery of 12·01 per cent for the week ending 1 February 1941, while several factories were getting recovery well over 11 per cent sugar regularly.

The excellent recoveries obtained during the season by factories encouraging the cultivation of Co 299 and Co 313 in their zones drew the attention of the industry to the excellence of these canes, with the result that the areas under these varieties have increased by leaps and bounds. Of the two, Co 313 is the more popular with the growers north of the Ganges as it germinates quickly and is a good cropper under most conditions; it is not yet so popular in the Patna Division, however, as it is in the Tirhut Division. Co 299 is an admirable millers' cane but it yields well only in certain restricted areas, and the conditions under which it does do well have not yet been clarified. Co 356 and Co 513, two new varieties released for general cultivation in North Bihar, are being multiplied on a large scale. Co 356, which seemed so promising at one time, is now coming in for a certain amount of adverse criticism, as it is reported from some quarters to be liable to attacks of top-borer and is not by any means free from susceptibility to red-rot.

In consequence of the lower cane prices prevailing this year, and of the restricted off-take of sugarcane from growers' fields, the area under this year's planted cane shows a very marked reduction throughout the whole province; and fears are now beginning to be expressed that not enough cane will be available even for the restricted sugar quota that is anticipated for 1941-42. Apart from the diminution in actual area, a great deal of damage has been done everywhere by borer and white ants. Weather conditions too have not been very favourable for the planted canes, but showers at the beginning of May, however, helped to improve matters. The present outlook is from very fair to good.

1941 Cattle Show, New Delhi

The Government Cattle Farm, Patna, maintains a pure Tharparkar herd consisting of about 550 head of cattle. Breeding bulls are purchased from this farm at the rate of Rs. 50

each by District Boards and local bodies. The standard of the animals raised can be gathered from the fact that in February last cattle from this farm which participated for the first time in the All-India Cattle Show won several prizes.

Two Tharparkar cows, two Tharparkar heifers and one Tharparkar bull were selected and sent to New Delhi to participate in the show. The judging for Tharparkar animals was on the first day of the show. The other Tharparkar breeders who took part in the competition were: The Imperial Agricultural Research Institute Sub-station, Karnal, Government Farm, Sind and a private breeder from Sind. The two milch cows and two heifers from the Government Cattle farm, Patna, were placed second and third in their groups respectively. The bull of the Government Cattle farm, Patna, was placed fourth in its class.

The results are gratifying in view of the fact that this was the first time Bihar won prizes at the Delhi All-India Cattle Show.

TIRUPPUR CATTLE SHOW, 1941

By T. Vinayaka Mudaliar, G.M.V.C.
Superintendent, Livestock Research Station, Hosur

TIRUPPUR is not a new name to readers of Indian Farming. Its cotton market is well known and its cattle show gains importance year after year. Thus Tiruppur plays an important part in both agriculture and animal husbandry work. Not a little of this credit goes to the District Agricultural Association, Coimbatore.

Under the auspices of the Association, the twenty-third Cattle and Pony Show, together with an agricultural and industrial exhibition, was held on 10 June 1941 and the two days following at Tiruppur. Mr A. R. C. Westlake, I.C.S., Collector of Coimbatore, opened the show, and Mr T. J. Hurley, M.R.C.V.S., D.V.S.M., I.V.S., Director of Veterinary Services, Madras, attended the show on all the three days and presided over the meeting held on the final day and distributed the prizes.

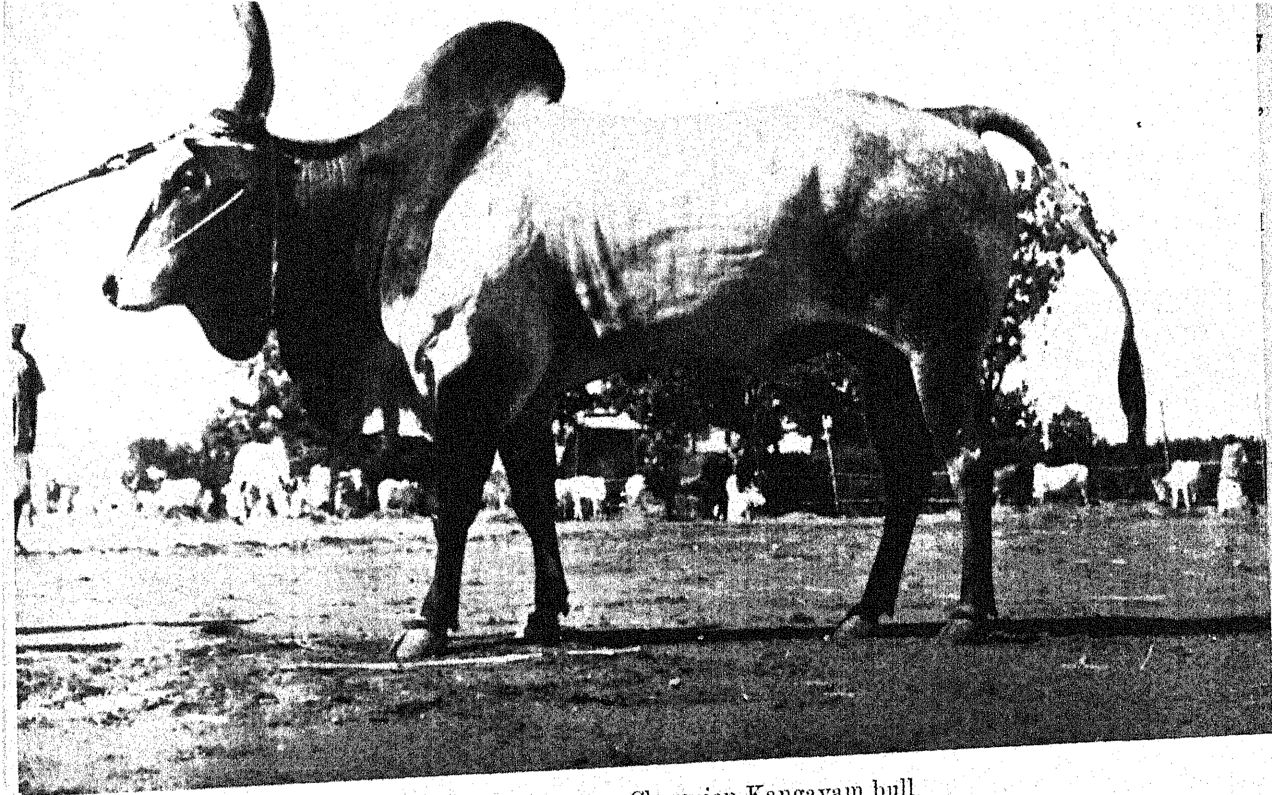
Two bullocks under one yoke

Mr A. R. C. Westlake gave a very thoughtful address and his reference to the importance of cooperation between the Agricultural and Veterinary Departments in the common interest of the ryot was greatly appreciated. 'As Director of Agriculture some time ago', said Mr Westlake, 'it did not take me long to realize the fact that Mr Hurley and I were like two bullocks under one yoke and unless we pulled together and pulled well, there was no possibility of success.'

This show, which for some time now has been a biannual affair, is to be held every year and this year's show marked the first step in that direction. The show ought to be considered against its background, the cattle fair which is held in connection with a local temple festival. The fair appears to be a very popular market for work cattle. The animals that gather at Tiruppur are mostly of the Kangayam breed. It is from this fair that animals for the cattle show are selected by the veterinary staff and sent in.

Brisk sales

There were in all 16,000 cattle and 400 ponies gathered at the fair. Of this number it is estimated that nearly 75 per cent were sold. About 200 Kangayam cows and over 2,500 Kangayam bulls were brought for sale. A few Mysore cattle were also to be seen. Nondescript bullocks in large numbers were also in evidence. A bunch of Barugur hill cattle belonging to the Pattayagar of Palayakottai attracted some attention. The condition of the animals was very satisfactory,



Tiruppur Cattle Show: Champion Kangayam bull

PLATE 130]

Champion Kangayam cow

Fruitgrowers on a visit to the Canning and Fruit Preservation Laboratory, Quetta

Assistant Marketing Officer, Baluchistan, explaining the drying of grapes to the visitors

taking into account the time of the year (June) when this fair was held. This is also a good market for ponies. They were mostly country-bred animals of what is ordinarily known as the Kathiawar breed. They are brought for sale by dealers from parts of Bombay and the Central Provinces. There is a good demand for the ponies, as could be seen from the fact that nearly 250 ponies were sold out of 400 brought for sale.

The Pattayagar of Palayakottai was the central figure of the show. The healthy influence his excellent specimens of cattle bring to bear on other breeders in the district cannot be over-estimated. There are a few more breeders of cattle coming up year by year and this year competition was admittedly keener than in previous years. As an instance, it may be stated that as many as 18 final entries competed under the class—Kangayam bulls, 4 teeth. The judges had a trying time in assessing the comparative merits of the fine specimens that walked into the show ring.

The entries under other classes were equally satisfactory. The extent of encouragement given to the cattle industry by the District Agricultural Association, Coimbatore, may be gauged from the fact that as many as 18 classes have been provided for under cattle alone and there were not less than three prizes for each class. Similarly, ample provision was made under different classes for horses, sheep, poultry and dogs.

Fear of the evil eye

An innovation this year was a milk-yield competition. Fear of the much-dreaded evil eye is well known. Much persuasion brought in seven entries, and the best milker yielded only 4 lb. in the morning. This was only a small beginning. With the gradual wearing down of the prejudice, there may be greater response under this item in future years.

The price of a good Kangayam bull ranged from Rs. 200 to Rs. 450 and that of a Kangayam cow from Rs. 90 to Rs. 200.

The popularity of this show is well established. Much spade-work has been done; and the time has arrived when the possibilities of running this show on more modern lines may be explored. The acquisition of a permanent site for this important fair seems to be an urgent necessity. It will be a step towards good marketing. Separate blocks for different classes of animals can then be allocated. There may be certain practical difficulties in the way, but still there is room for improvement. Markets, cart-stands, hotels, water-troughs, avenue trees, etc. can then be suitably located in a well-planned layout. Judging from past achievements it may not be long before a permanent site is acquired by the management.

BALUCHISTAN

By Nazeer Ahmed Janjua

Entomologist, Department of Agriculture, Baluchistan

IN order to give an impetus to almond cultivation and to convince the cultivators that almond orchards are commercially profitable, a 25-acre almond grove has been started at Duki (Loralai district). The plantation was completed by March 1941 and 4,320 trees have been put in. The idea is to provide the province with a striking example of what can be done by the people themselves working under effective technical direction. The owner of the land provides the labour and cattle power needed, while money is advanced by the Government in the form of *taccavi* loans. The Agricultural Department furnishes working plans, and expert assistance and manages the orchard in cooperation with the owner of the land. When the orchard comes into bearing, the *taccavi* loan will be paid back from the income of the estate, and it is hoped that within ten years or so the full loan will be cleared. At the end of ten years, the orchard will be handed over to the owner, who

by that time will be sufficiently educated to take over charge of his property and run it efficiently under the expert guidance of the Agricultural Department.

Scope for fruit juices

Experiments carried out at the Canning and Fruit Preservation Laboratory, Quetta, have shown the possibility of preparing a number of useful fruit and vegetable products from local produce. *Haitha* grapes can be successfully used for preparing the familiar *abjosh* of commerce and a high-class raisin can be prepared from *kishmish* grapes. A number of important varieties of grapes like *haitha, kishmish, tand, kalmak*, etc. can be used for preparing good quality juice. Pomegranates, which split on the tree due to some physiological factors and do not fetch a good price, can be converted into pomegranate juice which it is hoped will find a good market in India. In order to convince the growers that this can be established as a cottage industry, a demonstration was arranged at the Fruit Experiment Station, Quetta, for about 50 growers. They were shown simple methods for making *abjosh, kishmish*, grape and pomegranate juices. Encouraged by the results, a more ambitious step was taken when demonstrations on the drying of grapes and preparation of grape and pomegranate juices were arranged at several places in the Quetta-Pishin district in the growers' own vineyards and orchards. As a result a number of growers at Karez Inayatullah, Killa Abdullah and Malik Yar have started preparing these products on a fairly large scale. It is hoped that with further propaganda and encouragement, more and more growers will take to this industry.

Drive for potatoes

Potato is one of the important crops in the province. Its importance lies in the fact that the crop is available at a time when it is not ready in the plains. The season begins in June when the early crop is harvested. In September, the late varieties are dug out and these last up to the end of December. So far the development of this industry has, however, been greatly hampered by heavy freight rates and great competition in the markets from potatoes imported from foreign countries. After the outbreak of the war, it appeared that the markets would be open to home produce unless Kenya and other countries in Africa found it cheaper to sell their produce here. In order to encourage the cultivation of potatoes, the Baluchistan Administration advanced Rs. 2,250 as *taccavi* loans for the purchase and distribution of seed to growers through the Agricultural Department. The growers were greatly benefited by this arrangement. The growers' produce, along with that of many others to whom no potato seed was issued, was marketed by the Agricultural Department. In all 10,796 md. of potatoes were sold for Rs. 48,130.

Grading of grapes, peaches and potatoes was undertaken. The growers who had been doing the grading fully realized its importance, but it is regrettable that cooperation from others is not forthcoming. Efforts are being made for putting this work on a cooperative basis.

The locust menace

The locust *par excellence* of India, whether judged by the frequency of its visitations or by the extent of its attack, is the desert locust. Baluchistan is considered to be one of the important breeding centres in India. After a lapse of about eight years, the pest again became active and swarms were reported in the second fortnight of October 1940, entering the eastern parts of Baluchistan. With the appearance of these swarms, the indications were that a new cycle of infestation had started and further trouble was in store for the cultivator. On receiving information about the impending danger from the Locust Warning Organization, New Delhi, the Agricultural Department at once issued a warning throughout the province and a leaflet on locust control was immediately distributed. The Revenue officials were also given the necessary training for locust control. The Entomologist was deputed to keep under surveillance the areas known to be responsible for starting fresh outbreaks. It was, however, realized that the best way of dealing with the pest was to locate the centres of outbreak and destroy the incipient swarms before they assumed a

dangerous turn. In order to achieve this, an anti-locust scheme for Baluchistan (including the states of Kalat, Las Bela and Kharan) was sanctioned by the Government of India, from 1 March 1941. According to this scheme, the province is divided into 10 circles and each circle has an entomological staff for technical advice and district staff consisting of Revenue officials for doing the control work. As a result of a survey carried out by the staff, it was discovered that locusts were breeding heavily in Jhalawan and Kachhi areas of Kalat State and little breeding was going on in Bolan. Immediate steps were taken to control these locusts and handpicking of the adults and beating the hoppers by labourers engaged on daily wages was resorted to as the best method under the circumstances. During the three months, i.e. from March to June, 1,877,594 locusts were killed along with the daily beating of hoppers. The work is in progress.

Value of example

The entomological scheme for Baluchistan, which was retrenched in 1938 by the Government of India, has been revived from 1 March 1941. It has been realized that no amount of propaganda or demonstration on a small scale can convince the average grower of the importance of spraying fruit trees for controlling various pests. According to this new scheme spraying will be carried out in particular localities at Government expense for some years and it is hoped that the growers will, in the meantime, realize the importance and effectiveness of the work and ultimately take to it of their own accord. The work has been started and the drive is mainly against codling moth and black and green peach aphids.

The Month's Clip

VETERINARIANS IN NATIONAL ECONOMICS

L. A. MERILLAT, speaking to veterinarians at the California Veterinary Conference at Davis, California, on January 6-8, 1941, emphasized that veterinary science, by virtue of its name, should treat the domestic animals in every state of their existence. He pointed out, however, that in English-speaking countries in the past this science has dealt with diseases only. Animal medicine and animal husbandry have therefore drifted apart to mutual disadvantage and both have suffered from 'knowledge deficiency' when the one treks into the sphere of the other. In fact, both the two studies are interlocking and unavoidably the practice of one leads headlong into the other.

Veterinary science and agriculture have somehow to inform the people that increase of populations, development of wealth, prevention of want and pestilence, evolution of the arts and sciences, improvement of culture, human intelligence and physique, and the recreations which make life worth living, rest primarily upon a wisely directed animal industry.

Reason for obscurity

The reason why veterinary science as an economic question remains so obscure is that we have done the impossible thing of trying to separate animal health from animal diseases —two sciences which are inseparably dovetailed. Only wise economists realize that all we have in wealth, comfort and pleasure is the gift of the domestic animal populations that veterinary schools created. The underlying facts are overlooked in the chaos of an unprecedented industrial development which has intoxicated the population of this period. It is only now and then when spectacular infections of our animals sweep down upon us that the public becomes aware that we do have an army of disease fighters under arms prepared and trained for such emergencies. But, what the veterinary service does day in and day out on behalf of national economics is almost unknown to the people.

Stricken France remains self-supporting through the zootechnics that were taught in its veterinary schools. By appointing a veterinarian a minister of the Reich, Germany in less than 20 years became nearly self-supporting for the first time in its history. An insufficient animal industry wrote defeat into German history in 1918; a sufficient one in 1941 appears to be giving it control of a large proportion of the civilized world.

During the last 50 years veterinarians have made wonderful progress in handling diseases, but less has been accomplished in cementing the major branches together and convincing the public that domestic animals (their production, their health and their care in disease) is fundamental to the welfare of mankind.

Higher standards

In preparing our case for trial we must first raise our scientific standards and our professional conduct. We need larger schools and more veterinarians, better literature, better and more research, better skill, a broader knowledge of zootechnics, and better ethics. It is all a matter of going before the public with sufficient scientific attainment in the one hand and good conduct in the other.

Animal husbandry should be a major branch of veterinary medicine and someone particularly delegated to establish in the minds of the people the place domestic animals occupy in national economics. Zootechnics comprising a study of everything from the raising of song birds to the racing of horses and the production of wholesome food of animal origin should be taught systematically from the very beginning in the veterinary colleges.

No other group of this day, except a well-organized veterinary profession, exploits do-

mestic animals as a single unit and none is as competent to tell the story of the animal-disease potential in this civilization. It requires war or sweeping animal plagues to arouse the public conscience. The subclinical ailments which rob by stealth and cause uncomputed losses are not studied in national economics. Injurious plants, minerally deficient forage, worm parasites and insects, and viruses and bacteria and protozoa which gnaw at the profits of farming unnoticed are so many factors which never arouse sufficient public interest to bring about sustained programmes of control. It has taken this horrible conflict of arms to teach the lesson that man is subordinated by products of his domestic animal holdings.

Parent of agriculture

By common consent veterinary science is a branch of agriculture of which animal production is regarded as a sideline and we a fringe of the latter. The order needs revision. Animal production comes first because in order to farm there must first be animals to do the tilling and furnish food. The hoe and man-drawn plough could not have created much of a civilization. Even if Cain and Abel had used tractors, they would still have needed animals to feed their offspring. When Noah took to the Ark, he didn't take on a cargo of seeds and plants ; he wisely loaded up with animals in order to give agriculture a new start.

In organizing a front for our profession let us not yield one inch of ground in expounding the fact that what the world enjoys today in wealth and strength was started when veterinary schools and services were founded by Louis V. This means that animal production is the parent, not the child of agriculture, and that cultivating veterinary science which preserves the amplitude of animals, in the midst of a congested population, is a human duty of the top rank. The small amount of money appropriated for veterinary science and the meagre moral support it receives are not at all comparable to the debt owed to this branch of human endeavour. (Abstract)—*Journal of the American Veterinary Medical Association*, Vol. XCVIII, No. 768, p. 220.

GREENHOUSE PESTS CONTROL

THE growing of vegetables and flowers under glass is an important and constantly increasing industry in Canada. Such plants are attacked by many insect pests which greatly increase the care and attention necessary to insure satisfactory growth. Some of these insects may be controlled very effectively by the use of their natural enemies known as parasites, and the Dominion Department of Agriculture maintains a laboratory at Belleville, Ont., where these parasites are studied and cultured. The parasites are harmless to plants and animals and can be used in many places where it is not possible to use poisonous gas or sprays.

The greenhouse whitefly is one of the most troublesome insect pests. It attacks many flowering plants and also does severe damage to tomatoes and cucumbers. The adults are tiny, white, moth-like insects which fly about when foliage is disturbed. The parasite Encarsia has been used with excellent results in the control of this pest and during the last decade several million have been sent to growers in all parts of Canada from the Belleville Laboratory.

Another very destructive pest is the mealy bug. These are soft-bodied insects covered with a white material resembling powdered wax. There are several species of mealy bug and each has a special kind of parasite. It is most important, therefore, to know the kind of mealy bug that is present and a sample of the pest should accompany the request for parasites. Parasites of the two most common kinds are being cultured and are available for distribution.

A supply of any of the above mentioned parasites may be obtained free of charge on application to the Dominion Parasite Laboratory, Belleville, Ont. The following information is necessary to determine the number of parasites that will be required:

1. Greenhouse area and night temperature.
2. Crops infested and stage of development.
3. Area infested and whether infestation is light, medium or heavy.

Complete instructions are included with each package of parasites sent out.—*Press note, Dominion Department of Agriculture, Canada.*

MINERALS FOR HOGS

ONLY vigorous and healthy young pigs will develop into high quality bacon hogs. To obtain such young pigs, a balanced ration well supplemented with minerals is essential.

Too many losses still occur on the average farm, especially in young pigs, due chiefly to a deficiency of minerals in the ration, states U. Pilon, Livestock man at the Dominion Experimental Station, Kapuskasing, Ont.

A liberal feeding of minerals will not only prevent most of these losses but also better daily gains and a lower feed consumption per pound of gain will be obtained with growing and fattening pigs.

In hog feeding, four mineral elements along with salt are helpful, namely, calcium, phosphorus, iron and iodine. All other mineral elements are usually present in sufficient quantity in ordinary rations. Pigs require less salt than cattle but nevertheless a better utilization of feed will usually result from its feeding. Calcium and phosphorus are also important to prevent rickets, weakness, short lactation and paralysis in hind legs with nursing sows. Furthermore, it is admitted today that iron is an effective remedy against the all too common disease in young pigs called anæmia. Also goitre and hairlessness can be easily prevented by feeding iodine to the pregnant sow.

Chemical analyses have shown that the grains and their by-products are generally low in some of the essential minerals and to be sure that the ration is not deficient, it is advisable to include 3 to 4 per cent in the dry meal mixture for brood sows and 2 per cent for all other pigs, of a commercial or a home mixed mineral mixture such as ground limestone 50 lb., bone meal 25 lb., and iodized salt 25 lb. This mixture has given excellent results at this station. Iron in the form of iron sulphate at the rate of 2 lb. in the above mixture can be fed if anæmia occurs. Another remedy for this condition is reduced iron which can be fed directly to the suckling pigs. Where a lack of iodine is evidenced by goitre or hairlessness one teaspoonful of the following solution (one ounce of potassium or sodium iodide diluted in 1 gallon of water) should be fed daily to the pregnant sow in her ration.

Adequate mineral feeding costs so little that it is poor economy after all to neglect it if we consider the benefit which may be gained.—*Press note, Dominion Department of Agriculture, Canada.*

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MACHINERY DURING WINTER

THE care that farm machinery receives during the winter months is an important factor in the life and cost of equipment, according to T. S. Forsaith, Dominion Experimental Station, Swift Current, Sask., who makes the following suggestions :

Before winter sets in each piece of machinery should be given a thorough inspection. All parts should be well cleaned and all bearings and other moving parts given a generous greasing or oiling. Polished surfaces such as plow moldboards and cultivator shovels need a good coat of heavy grease to prevent rusting. Roller chains should be thoroughly cleaned in gasoline or kerosene and re-oiled. Binder, combine, and mower sickles should be removed and stored inside. All dirt, straw, and trash should be removed from drill boxes, and from the straw racks, chaffers, augers, and elevators on separators and combines. Dirt holds moisture and promotes rusting and decay.

While this cleaning and greasing is being carried on is a good time to make a careful check of all worn and broken parts that will need replacement immediately or in the near future. In any case, repair parts should be ordered so that they will be on hand when required. It is important to keep all machines in first class running order. Time lost through breakdowns is expensive, and what is perhaps even more important, a worn machine cannot do a first class job. One worn part often causes other parts to wear more rapidly, and breakage of one part may lead to breakage or damage other parts.

Paint is a great preventative against those enemies, rust and decay, and also adds to appearance. The life of wooden parts in particular is lengthened by regular paintings. For best results the machine must be thoroughly

cleaned of all loose paint, rust, dirt, and grease and a good quality implement paint applied under dry, warm conditions.

Shelter is good for those machines which have many wooden or moving parts, such as binders, combines, drills, and wagons. Tractors should be stored inside if possible. Most tillage implements suffer little harm from the weather if properly cared for. Where machines are kept outside it is a good plan to remove wooden parts such as binder reel slats and arms, tongues, and wooden wheels and store them under cover.

Implements with rubber tires should have the weight blocked off the tires if stored inside, or if kept outside the wheels should be removed and stored inside. It is a good idea to give all rubber tires a coat of rubber preservative.

Proper care given to machinery when not in use will be repaid many times in increased life and efficiency.—*Press note, Dominion Department of Agriculture, Canada.*

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BOMBING EFFECTS ON LIVESTOCK

MANY of the bombs dropped during the recent intensive raids have fallen in rural areas, but despite this the mortality in farm livestock has not been as heavy as might have been expected. Cattle have been the principal victims, followed by sheep, chiefly because of their tendency to herd together. Well down on the list come horses and pigs.

Reports from dairying areas indicate that the disturbance of explosions and machine gun fire appear to have little or no effect on the output of milking herds.—*Canadian Dairy News Letter.*

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HONEY

IF the value of honey were to be fully realized, the quantity at present produced for consumption would undoubtedly be more than doubled. In America the consumption of honey amounts to approximately 8 lb. per head per year, and in England to approximately 4 oz., whereas the consumption per head in South Africa can hardly be calculated in ounces.

In America much prominence has been given to honey by the medical profession with the result that, in that country, it is regarded as a valuable nutrient and stimulant.

The value of honey lies chiefly in the fact that the sugar in it is present in a very simple form. Besides sugar, honey also contains acids and mineral salts required by the body. Some of the sugars found in honey are: cane sugar (sucrose), grape sugar (dextrose), and fruit sugar (levulose). In the honey, the last-mentioned two kinds of sugar already exist in converted form, with the result that they can be assimilated by the blood as soon as they have been consumed, whereas cane sugar must first be converted by the gastric juices before it can be taken up by the blood.

According to analyses, honey contains approximately 75 per cent of sugar already converted, and approximately 2 per cent of cane sugar. Since most of the sugars in honey consequently require hardly any digesting (although honey ranks high in caloric and energy values) they can directly be taken up in the blood stream, and, the body will immediately derive the fullest benefit.

Advantages of honey

(1) No germs can exist in honey which is highly hygroscopic, i.e. moisture-absorbing. All germs which find their way into honey are immediately destroyed when the moisture in their bodies is extracted by the honey.

(2) Honey contains mineral salts essential for good health.

(3) It is a palatable food.

(4) It is an energy-producing food.

(5) It has already been converted by bees and is almost immediately taken up in the blood stream.

(6) It has a healing effect in cases of indisposition of a light nature, such as affections of the chest and the throat, etc.

In his book *Honey for Health*, Sir Arbuthnot Lane of the Lady Margaret Hospital writes as follows: 'Honey is a food full of energy and therefore stands high as a producer of stamina and strength. Those who add honey to their daily diet may be assured that they are adding to their capacity to work with hands and brain. If every traveller would

ask at his hotel for honey with his porridge or cereal foods, he would be far more fit to tackle the day's work. Honey has practically no waste matter in it. Extracted honey is one of the few foods that is all food and is easily digested.'

In order to encourage beekeeping and the production of honey in South Africa, the Department of Agriculture and Forestry has created a special section in the Division of Entomology to serve the interests of apiculture. This section has an experimental apiary near the Union Buildings, Pretoria where experts are able to do research work in connection with bee problems. If desired, any further information on this important subject may be obtained from the Chief, Division of Entomology, P. O. Box 513, Pretoria.—F. A. Deale, Extension Officer, Pretoria.—*Press Service, Department of Agriculture and Forestry, Pretoria.*

New Books and Reviews

Soil Conservation

By H. H. Bennett (McGraw Hill Publishing Co., 1939, pp. 994, 40*s*.)

THE importance of any problem to the community at large may be judged to some extent by the number of textbooks which are printed about it. The growing importance of soil erosion as an immediate menace to many countries of the world is clearly reflected in the number of major publications which have appeared within the last two years, after a kind of probationary period of some 20 years, during which the subject has been explored in a number of short papers which have appeared in many scientific journals.

The author is the head of the Federal Department which started in 1933 under the name of the Soil Erosion Service, but this was quickly altered to Soil Conservation Service as being a more constructive name for what must be essentially a progressive and largely experimental technique. Since then this young department has introduced the science of soil conservation to almost every farmer in the whole of the United States, extending from the first pioneer project areas where the farmers had more or less to be bribed into accepting the guidance of Government until now any group of farmers can elect themselves into a district committee which is given the most spectacular and revolutionary powers of control in enforcing programmes of better farming and conservation practices. Dr Bennett's previous experience in soil research has therefore been tested in what is outstandingly the best attempt so far at organizing soil erosion control measures on a nation-wide basis.

With nearly a thousand pages and plentiful photos the author has produced a really monumental work which covers every phase of the problem, and combines under one cover the findings of many scattered technical papers which are no longer available to the ordinary worker in this field. One of its main uses should be in clearing up the actual definition of certain phrases which have been adopted as popular catchwords and are quite frequently misused. It also has amassed a formidable body of figures with which every agricultural worker should be familiar because they show how clearly the welfare of the farm depends upon the soil. If this is allowed to become a wasting asset, as has already happened in the more easily eroded but very valuable light loams, the whole agricultural balance is upset because it precludes any chance of establishing the farming community on a permanent basis of sustained production. 'What makes this situation so grave is the irreplaceable nature of soil. Once this valuable asset leaves a field, it is as irretrievably lost as if consumed by fire, as far as that particular field is concerned. It cannot be hauled back economically even though stranded only a short distance down the slope. A thousand tons would be required to cover one acre to a depth of seven inches.'

The figures given for available plant food washed down to the sea from American fields are almost too huge for comprehension. For a country where every farmer uses fertilizer as a matter of course for most of his crops, erosion removes from American fields and pastures every year plant food amounting to about 60 times the amount put back as fertilizer and manure. What must the ratio be for India, where manuring is done by handfuls and fertilizer is seldom used, while sloping fields and grazing grounds continue to be washed away by every storm ?

Beyond this problem of wasting land in India lies the spectre of starvation, and the breakdown of the existing social structure through sheer desperate want in our agricultural slums. And beyond that again is the intimate physical relationship of eroding land to mounting flood heights and to dangerous silt deposits in the lower reaches of our rivers. No permanent control of these latter two

problems appears possible without better control of run-off all the way from the hill-tops to the sea. Flood control means control of erosion, the one necessarily involves the other. In India, we are too much inclined to throw the onus for action upon Government, but this is what Dr Bennett says, based on his experience as the controller of possibly the largest organization for agricultural planning that has ever been attempted anywhere: 'Conservation of the soil, in a national sense, requires the adoption of sound land-use principles and practices by agriculture as a whole. . . . . The responsibility for such a national programme [such as has been drafted for India by the Indian Congress' National Resources Board] falls upon both the nation and the individual. National responsibility involves the protection of society's interest in a natural resource of vital importance to the whole people. Government functions properly in discharging this responsibility. Equally strong, however, is the interest of the individual in the land that he owns. National action may be led and aided by Government, but the soil must be conserved ultimately by those who till the land and live by its products. Without a widespread recognition of this latter responsibility, any Government programme of soil conservation must be doomed to eventual futility and failure.' We in India must remember this.

Soil erosion is now generally recognized in the United States, as it ought also to be in India, as a powerful and destructive force which directly or indirectly affects the lives of every man, woman and child. It is understood now not as a freak of nature which occasionally turns up on isolated hillsides, but as an almost continuously active process which attacks countless fields, whole watersheds and catchment areas and interferes with the economic prosperity of whole farming communities. Much of the evidence produced in America during the last decade of very active enquiry can be applied directly to Indian conditions. An inadequate water supply is at the bottom of the Indian cultivator's worries, and a properly planned agriculture which husbands the seasonal rains into storage ponds for use by stock in the dry season will do much to alleviate the trouble. But mounting stores of silt in the pond bottom are a poor preparation against subnormal rainfall, and efficient water catching must start with grazing control, the substitution of grazing by grass-cutting, the reduction of surplus stock, and the proper feeding of selected animals. The Indian farmer has got to learn, just as the American farmer is now beginning to learn, how to hold a greater proportion of the available rainfall in his own fields. This can be done by various practical measures such as contouring, terracing, and strip cropping so that more of the rain is stored in the soil and thus made available for subsequent crops. Conversely, the reduced absorptive capacity of land as the result of exposing dense clay subsoil by erosion, together with the increased difficulty that plants encounter in taking moisture from such clay when dry, hard and resistant to penetration, is essentially the equivalent of a reduction of the rainfall, so far as the growth of plants is concerned.

The book gives a vivid and well-illustrated account of the soil phenomena connected with erosion in all its phases, including the farmer's failure to realize how the gradual spread of sheet washing is robbing him through the sealing up of the soil pores by the puddling of rain-washed soil on bare fields and grazing grounds, then the gradual development of the various other forms of erosion including soil fragmentation, the formation of erosion pavements of residual stones after the surface soil has gone, then the appearance of gullies. The definitions of many new erosion terms are most accurate and clear so that the book constitutes a mine of information. The author also points out the many lines in which information is still lacking and appeals for further research to be done along these. He also explains how the classical hydraulic 'laws' are of only theoretical value, and have still got to be substituted by something more in keeping with practical run-off data. For instance, the principle that the weight of a particle which can be moved by flowing water varies as the sixth power of the velocity is challenged. Dr Bennett suggests that the weight varies with the fifth power or possibly slightly less in practice, and that the

quantity of material which can be moved will vary as the fourth power, i.e. if the velocity is doubled, the quantity will be multiplied by 16 only and not by 64. Even so, the power for evil and damage of which a flooded silt-laden stream is capable has to be seen to be appreciated. The average results of many thousands of measurements of the effect of individual rain storms on 13 types of farm land show that under the exposure of clean tillage and bare fallow, soil is lost at a rate of about 95 times as rapidly as from good grass or dense crops, and that nearly seven times as much of the rainfall is lost as run-off from plough land as from land protected by vegetation. So we know where the silt comes from that chokes the rivers.

Turning now to the forest, the reader is tremendously impressed by the colossal amount of destruction which has taken place in the development of the present American civilized community out of a land rich in primeval jungle and waving grasslands. In applying these lessons to India it is easy to say that India is an old country and that such destruction cannot therefore take place now. But it is taking place now in every village grazing ground throughout the length and breadth of India. The degradation and deterioration of the vast grassland resources of the American south-western grazing grounds by too heavy stocking with cattle and sheep is being duplicated in every Indian village where hungry herds of cattle and goats and sheep are destroying the remaining vestiges of herbage, in what was formerly scrub jungle with a reasonably thick cover of low trees, thorn and bush growth, and grass. What is left is the bare skeleton of what was once a valuable natural resource.

An essential part of better land management is to reconstitute these uncultivated 'wild lands' and set aside part of them for tree growth and grass production. The equivalent of the American farmer's private 'wood-lot' could be of enormous value to the Indian cultivator in supplying him with building timber, firewood to use instead of burning cowdung, fruits, tanning material and many other forest products, besides giving a good contribution towards stabilizing the local water supply by reducing the storm run-off.

Another phase of land management which the author advocates is stream-flow measurements, so that we can have a sounder body of knowledge about the behaviour of the smaller streams which together constitute our river systems. A new type of control station to measure bed loads, suspended silt loads and other hydraulic problems dependent on stream velocities, is yielding data which are being correlated with topography, land use, and catchment area conditions in a number of research stations such as Statesville and Greenville in North and South Carolina respectively. Similar data for a variety of Indian conditions such as the Punjab foot-hills, the Central Provinces plateau and the Etawah ravine lands would be of the greatest value.

The value of contour furrowing or contour ridging on uncultivated land is now fully appreciated in the States and the lesson is being applied on an ever-widening scale. It has not yet been appreciated in India what an immensely valuable contribution this can be to agricultural production if done on a fairly large scale on village wastelands. It causes a marked improvement in both the quality and quantity of forage, particularly where rainfall is scarce or erratic. For example, a block in Hereford, Texas, was furrowed four inches deep and eight inches wide with furrows spaced 7 ft. to 14 ft. apart and produced 1,761 lb. of dry grass per acre as against only 704 lb. on an untreated comparable plot. In another Texas station called Spur, an area which had been contour-trenched produced 2,369 lb. per acre of dry grass when the untreated control plot produced only 725 lb. The book gives much valuable information about the details of construction and layout and methods of ploughing such contour ridges.

I should like to hand on the author's wise words with which he warns us against avoiding controversial issues on the relative merits of the various phases of erosion control, particularly in the choice as between leaving it to nature, which is the remedy advocated by many forest officers, and a more active and

comprehensive programme which will make use of all or any of the possible aids—rotations, strip-cropping, terracing, controlled grazing, and so forth. This book by Dr Bennett is a reliable guide in all of these and much more besides, which can be applied directly in helping the Indian farmer to make his land permanently productive.—[R. Maclagan Gorrie]

From All Quarters

AGRICULTURAL SCIENCE

THE June issue of *The Indian Journal of Agricultural Science,* one of the scientific journals issued by the Imperial Council of Agricultural Research, has in it several articles which may be interesting not only to specialists but also to others. Dr P. V. Sukhatme, Statistician of the Council, deals with economics of manuring, based on certain experiments in which different quantities of groundnut cake were used for the manuring of rice. Dr Rege and Mr P. V. Wagle, of the Padegaon Agricultural Research Station in the Bombay-Deccan, contribute the third of their articles on problems of sugarcane physiology in the Deccan canal tract and in this issue deal with the effects of soil, water and manure on root development. Mr R. S. Koshal of the Technological Laboratory, Matunga, contributes an interesting article entitled 'A Study of Forecasting of Cotton Crop in the Punjab' and makes suggestions for the conducting of crop-cutting experiments in order to ensure more satisfactory results. Dr Hem Singh Pruthi and Mr C. K. Samuel, of the Imperial Agricultural Research Institute, deal with the leaf-curl disease of tobacco in North India and show how it can be transmitted by white fly from other hosts. Dr R. S. Vasudeva and others contribute two articles on the root disease of cotton in the Punjab and Dr Rahman and Mr Abdul Wahid Khan (also of the Punjab) give an interesting account of the effect of the parasite *Aphelinus mali* on Woolly Aphis pest of the apple tree. The issue concludes with a reprint of a very important article by an American Professor and two Chinese students on the water requirements of rice irrigation.

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RESEARCH AND WAR EFFORT

THE scientific journal *Nature,* in its issue of 12 April 1941, contains an article headed 'Science and the National Effort', being a précis of a statement made by Lord Hankey before the House of Lords on 2 April 1941. Lord Hankey was speaking from his six months' experience as chairman of the Scientific Advisory Committee set up as the last official act of the late Mr Neville Chamberlain. After a review of the personnel and contacts of this Committee and after dealing with certain other relationships of the Committee the article states :

'The Agricultural Research Council, with its twenty-five standing and technical committees of men of science with special experience of the matters with which they are concerned, with its Field Experimental Station, and with its great influence on the work of the twenty-three existing agricultural research institutes and other agricultural research subsidized by the Government, also makes an important contribution to our war effort.'

Later in the article the Council is again referred to thus :

'The Agricultural Research Council, as at present organized, has not the same freedom of initiative and action' (as the Department of Scientific and Industrial Research and the Medical Research Council in Britain). 'Believing the scientific development of agriculture to be of the greatest importance to the country, both during and after the War, the Scientific Advisory Committee has drawn up proposals for strengthening fundamental research and ensuring a more ready application of promising scientific discoveries to agricultural practice.'

Later on in the same issue of *Nature,* the character of these measures is thus indicated in a statement regarding a supplementary vote passed by the House of Commons for the Ministry of Agriculture, on 3 April 1941 :

'The Agricultural Research Council is to be granted an increased sum for use at its unfettered discretion for promoting basic or fundamental research. Thus it is hoped to use for the advantage of agricultural research the best brains of the scientific world. The

Minister proposes to appoint for England and Wales a body which will be directly responsible to him and which will be concerned to devise methods for ensuring that promising results of research are applied as rapidly as possible to the problems of agriculture and incorporated in the everyday practice of the farmer. A similar body is to be appointed for Scotland. The question of the reform of agricultural education is also to be considered.'

KSHITISH CHANDRA BANERJEE

WE regret to announce the death, on the 28th May, of Mr Kshitish Chandra Banerjee, B.A., L.Ag., Rice Research Officer, Bankura. Mr Banerjee, who belonged to the Bengal Agricultural Department, was appointed Rice Research Officer in 1932 when the scheme of rice research was started by the Imperial Council of Agricultural Research with the aid of the late Empire Marketing Board.

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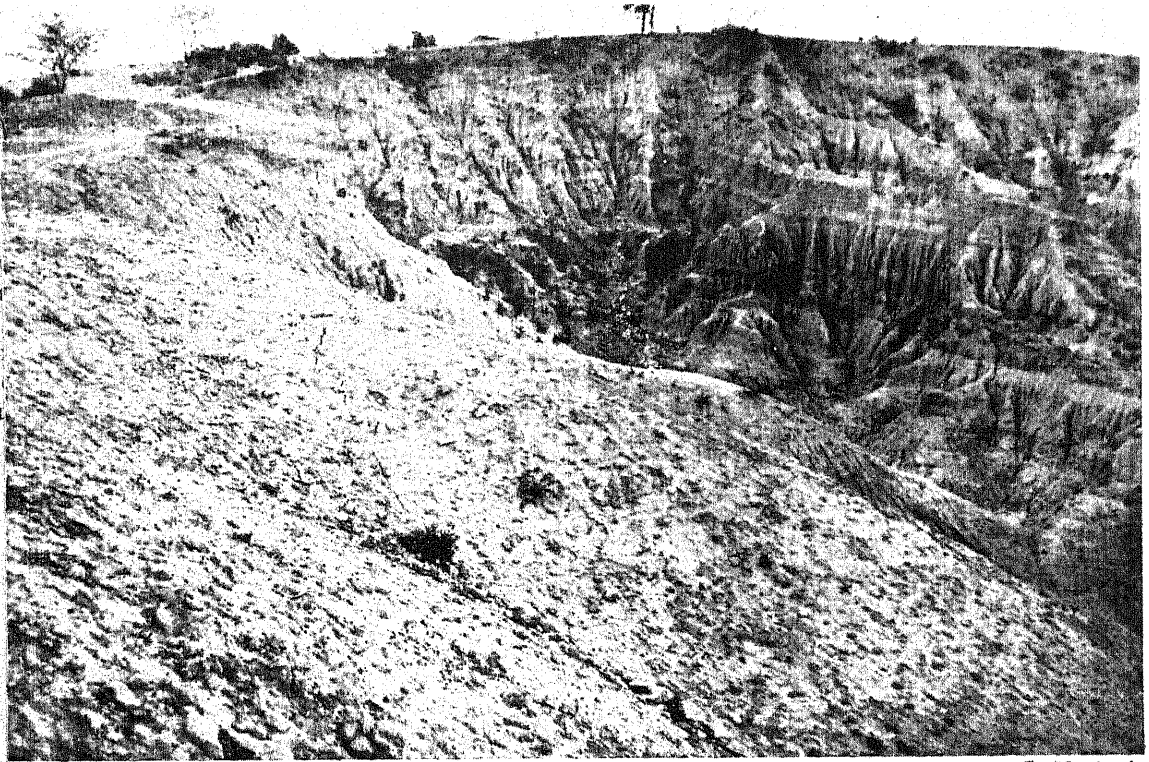


R. M. Gorrie

Foreground is a Gujars' field in Kurmala *abadi* of Kuthar (Hoshiarpur, Punjab) where erosion is so far advanced that ploughing is no longer possible. Background shows a typical gully head.

Village 'pastures' of Mankoli Jatoli (Hoshiarpur, Punjab) looking north from centre of 'bad lands' across the Sutlej towards Nandadevi peak (on right sky line). The Sohan valley has about 300,000 acres like this.

[PLATE 132

R. M. Gorrie

INDIAN FARMING

ISSUED BY THE
IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II OCTOBER 1941 No. 10

BACK TO THE SEA

THIRTY years ago there was current a comic song in which the singer announced that he knew where flies go to in the winter time. What we need at present is a tragic singer who will din into the ears of administrators and cultivators where the good earth goes to in the monsoon.

The impatient reader will now probably exclaim : 'Another sermon about erosion !' Readers, however, are not impatient regarding repeated sermons on A. R. P. or fire insurance, simply because the dangers are more vividly apprehended. The reason for this particular sermon on erosion is the striking exhibition in action of three well-known kinds of erosion in the course of one single day's journey across Central and Western India.

On July 13th, 1941, the writer travelled from Delhi to Bombay by the G. I. P. Railway route. Immediately in the vicinity of Dholpur there is a large stretch of country which might be mistaken for the Dakota Bad Lands. This is not by any means the only place in India where such erosion is to be found. On the B. B. and C. I. Railway line in Central India there are several similar places and there is a very bad area in the Punjab that can be seen from the railway line between Jhelum and Wazirabad.

To continue our journey across Central India towards Bombay : a little further south, just beyond Hetampur, wind erosion was in full blast. There had been little rain. Much of the land had been tilled but not cropped and 'dust devils' were busy carrying the soil into the air all over the place.

Next morning one awoke to a totally different set of conditions. Between Chalisgaon and Nasik the train passes through a country of medium black cotton soil with gentle slopes. Here there had been very heavy rain, in some places amounting to flooding (only recently drained off) and one saw, in full action, sheet erosion and incipient gullying.

This is one of the areas in which, in the dry season, the uninstructed might consider that no erosion problem exists. There is no doubt about the erosion if one sees rain water actually on the ground. At such a time one learns also how little the danger has been recognized by the cultivator himself. As often as not, he is ploughing up and down the slope instead of across it. Moreover, the field boundaries often act as guides for the beginning of erosion and there is no attempt at *bunding* (probably on account of the gentleness of the slopes). The headlands between fields, however, are fairly broad and generally covered with grass (naturally cropped short by ubiquitous grazing animals) and these headlands if placed along the contours could be turned into useful grass strips which would provide grazing and also control run-off.

It has been argued that anti-erosion measures are first and foremost a matter of dealing with the forest areas (or what should be forest areas) in the upper reaches of the catchment of great rivers. The subject is discussed in an article entitled 'Farmers and Forests' elsewhere in this issue. This is certainly one aspect of the work; but there are others. The fact is that erosion is a

big problem and has to be tackled on a big scale. Hence the recent discussion in the Imperial Council of Agricultural Research on really large anti-erosion projects, i.e. of the order of 30 to 100 square miles each, in which anti-erosion measures could be applied to all the features—large and small—of an erosion-affected block of country. Such a scheme would envisage the control of water by suitable afforestation and embankments in hills and catchment areas, the making of soaking compartments or similar devices lower down and finally the application of contour *bunding* and strip-cropping in the cultivated areas, with a final controlled run-off in such a way that the water would escape without cutting back into the land and without carrying away with it more than a fraction of the silt brought down from higher levels.

The title of this editorial is the answer to the question: 'Where does the good earth go to in the monsoon?'

SIR EDWIN BUTLER

C.M.G., C.I.E., F.R.S., D.Sc., LL.D., M.B.

An Appreciation

SIR Edwin Butler, Secretary of the Agricultural Research Council, Great Britain, has recently retired. Sir Edwin served in India from 1901 to 1920. He came to this country as Cryptogamic Botanist to the Government of India and was appointed Imperial Mycologist in 1905. He was Joint Director, Agricultural Research Institute, Pusa, in 1919 and Agricultural Adviser to the Government of India in 1920.

'An acknowledged leader in his own subject, mycology,' writes *Nature*, 'he had, as director of institutions in India and Great Britain, gained a wide knowledge of the problems and the methods of the agricultural investigator.'

The Agricultural Research Council of which Sir Edwin was the Secretary is charged with the scientific supervision of the widespread organization for agricultural research in Great Britain and its policy has been to guide and stimulate work in progress at research institutions rather than to attempt control. In giving effect to this policy, says *Nature*, Sir Edwin proved himself an ideal secretary. He quickly made himself familiar with the work of the research institutes and he visited them frequently. Nor was he an unwelcome visitor, since directors and members of staff alike soon found that in him they had a real friend, always ready to interest himself in their problems, always ready with helpful suggestions. To the Council the contacts thus established were invaluable as were also his detailed descriptive reports. His conclusions could be accepted with confidence; they were marked by proofs of full understanding, careful weighing of evidence and absolute fairness. His personal qualities made him the best of colleagues and it was with great regret that, because of the verdict of his medical advisers, his resignation from the secretaryship was accepted.

As Imperial Mycologist, Sir Edwin Butler trained a large number of mycologists for agricultural service in India. Mr J. F. Dastur, until recently Mycologist to the Government of the Central Provinces and Berar, a pupil of Sir Edwin, writes as follows:

'Sir Edwin, from the day I knew him, was anxious to set up a school of Mycology; and took a keen interest in training young men so that when the time came for him to drop harness he would leave behind him a band of young research workers as enthusiastic as himself. He was never too busy to give advice or to solve the difficulties of his *chelas*. He was as ready to give praise for good work

A threatened village in the ravine land of Etawah

[PLATE 134

The Honourable Sir Girja Shankar Bajpai, K.B.E., C.I.E., I.C.S.
Member for Education, Health and Lands, Government of India

[PLATE 133

done, or attempted, as he was ready to castigate a slacker.

He had the true spirit of the scientist and research worker. He never took credit to himself for the work done by others, even when he could have legitimately done so for some important discovery; especially when the investigation was carried out under his guidance and direction. Nothing gave him more pleasure than to see one of his men, assistant or student, do a piece of good work, and Sir Edwin saw to it that he received the full credit for it. His own share in the work he always kept in the background.

Any work that Sir Edwin undertook was done with great care and patience. When he wrote his book *Fungi and Disease in Plants* every statement that he made was carefully vetted. He did not rely even on his own notes. Every specimen, if available in the herbarium, was re-examined macroscopically and microscopically before he wrote an account of it for his book. Every reference or quotation was checked several times, from the original publication as far as possible, and the dictionary was in constant use. When the proofs were received he devoted the same vigilance and care to their correction.

Sir Edwin was a keen sportsman, though due to an unfortunate injury to his knee while playing hockey for his college he was unable to take any part in sports. In sport as in the field of science he was eager for members of his section to make a name for themselves.

Sir Edwin was loved and respected not only by the members of his section but by all in Pusa and that was no mean achievement.

SIR GIRJA SHANKAR BAJPAI

K.B.E., C.I.E., I.C.S.

SINCE April 1, 1940, on appointment as Member of the Viceroy's Executive Council for the Department of Education, Health and Lands, Sir Girja Shankar Bajpai has been *ex-officio* Chairman of the Imperial Council of Agricultural Research. From 1932 to 1940, as Secretary of the same Department, he was intimately associated with the work of the Council and with agricultural development throughout India. These are only two of the many important posts which he has held in the course of his career and he is now about to take up a new and unique post as Agent-General for India in the United States of America where he will be attached to the British Embassy at Washington with the status of a Minister.

At the last meeting of the Governing Body of the Imperial Council of Agricultural Research held in New Delhi on July 28 and 29, that body expressed its regret at losing Sir Girja Shankar Bajpai but also recorded its great satisfaction at his new appointment. The chief speaker was Sir T. Vijayaraghavacharya, the oldest member of the Governing Body and the first Vice-Chairman of the Imperial Council of Agricultural Research. Various other speakers joined in remarks of appreciation and farewell.

Sir Girja Shankar Bajpai's career and qualities have been elsewhere described, particularly in *Indian Information* of June 1, 1941. It is worth noting that Sir Girja Shankar's original education was scientific (he graduated as B.Sc. from Allahabad) but that when he went to Oxford, he took up modern history and also did brilliantly in logic and psychology. The breadth and catholicity of his early training, added to his natural ability, has enabled him to deal successfully with many thorny problems in the course of his career. Any one who has sat under his chairmanship will be glad to pay tribute to the clearness of his mind and to the spirit of compromise which he shows along with quick and effective decision. The good wishes of Indian agriculturists follow him in his new sphere of action.

A threatened village in the ravine land of Etawah

Original Articles

FARMERS AND FORESTS

By S. H. Howard, I.F.S.
Inspector-General of Forests

WOOD, the product of forests, is so much part of the everyday life of all of us that we tend to forget how necessary forests are. From birth to death a man is dependent on wood. He is born on a wooden bed, often feeds with a wooden spoon from a wooden bowl, uses at school wooden rulers and writes on a wooden slate, plays his games with wooden sticks, sits on a wooden chair, does his work at a wooden table, wears wooden clothes (artificial silk), reads a wooden newspaper (newsprint), and eventually, when he is dead, is carried away on a wooden stretcher to be buried in a wooden coffin or burnt with a wooden fire.

We all need wood for our houses, wood for our carts, wood for our trains, wood for our ships, wood even for our aeroplanes; our medicines often come from wood products (e.g. Cinchona bark) and it is impossible to pass through any day without making continuous use of wood or wood products.

It is sometimes suggested that the numerous substitutes used nowadays for wood will lessen the demand, but new uses for wood arise even more quickly than substitutes for it, so that, for as far back in the world's history as we have records, the annual consumption of wood per head of population has steadily risen.

It is not only wood and ordinary wood products that the forests provide. They provide both grazing for the cattle and shade for them. Above all, for the ordinary villager they provide fuel.

The fuel problem

If you do not live near forests you will know how difficult it is to get suitable fuel. You will know that crores of maunds of cowdung are burnt yearly as fuel and the burning of this valuable source of manure deprives the fields of its benefits, reduces the fertility of the soil and consequently the food available in India. But near most farms there is land which is not suitable for growing agricultural crops and yet which could very easily support forest crops. Nor need this necessarily encroach on the village grazing land, because by regulating the grazing the farmer can very easily increase the production of hay by three or four hundred per cent. The numerous mango *baghs* in India are often badly managed and, if treated properly, could not only produce more mangoes, if mangoes are required, but could produce a large quantity of fuel from quick-grown species which would go far to solve the fuel problem in those areas where fuel is scarce.

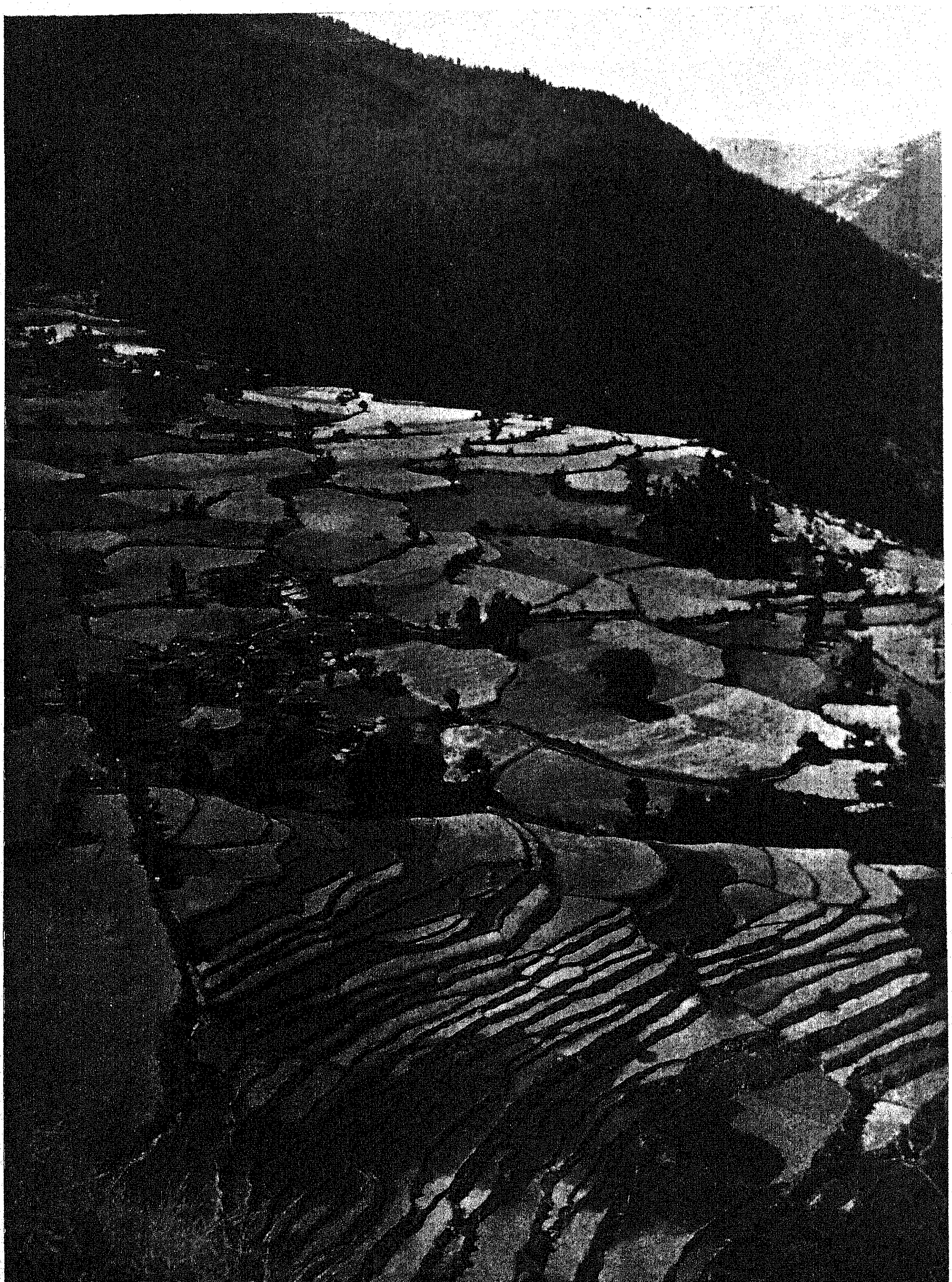
It is sometimes stated that the Indian villager prefers to burn cowdung rather than wood because of its peculiarly slow burning and smouldering properties. But given a cheap local wood fuel he would usually substitute it for cowdung. Even for those very slow burning processes for which the cowdung seems necessary, a perfectly good substitute could be made locally in the villages by first burning the wood into charcoal and then making the charcoal into what are called briquettes which, if mixed with clay, can be made to smoulder away as gradually as cowdung.

If gradually the uses of locally grown fuel could be substituted for cowdung and the cowdung released for manuring the fields, the whole economy of the countryside might be changed.

Taungya *system*

Near many of the large reserved forests in northern India, there has arisen a very close relationship between the agriculturist and the forest officer. A system called *taungya*, or perhaps more popularly *ban kheti*, has enabled them to help each other. The forest officer

A threatened village in the ravine land of Etawah



Correct land management. High hills covered in the forest and cultivated slopes properly terraced.

is not the enemy of the villagers he is often supposed to be, and if you enquire from these *taungya* villagers you will find he is often their best friend. The system is that when the forester cuts down the forest at maturity, he allows the villager to cultivate the land free of charge. Depending on the forest species, this cultivation in a given place may last from two to four years. The villager sows his crop in the normal way and reaps the produce which belongs to him. In addition, he is given free grazing for plough-cattle, firewood and various other small amenities. In return he sows the forest crop in lines between his own agricultural crop. The trees grow and in the second to fourth year, depending on the species, they close up and make the crop unprofitable for the agriculturist who then moves on to another plot. The forest officer has so arranged matters that the *taungya* villager can revolve in a circle round his village so that he is never without his normal annual area for cultivation.

Anyone who has seen the crops of the *taungya* cultivators knows how far superior they are to those on the poor tired land outside the forests. The Forest Department took up these villagers poor, starving and sometimes criminal, advanced sufficient money for the seed crop, and, within a few years, there were prosperous and contented villagers comparatively well off, with their own schools and doctors and able to provide the following seed crop from their own resources. In addition to all this, forest work is largely seasonal and it happens to fit in with the slack season of the cultivator, so that at those periods of the year when he is not engaged in his own work he can find employment in the neighbouring forests. Those villagers look upon the forest and the Forest Department as their best friends.

Checking soil erosion

But there is a further way in which forests affect the farmer. If any of you have seen the terrible ravine lands of the Jumna and Chambal rivers where more than 200 square miles of the earth's surface have been rendered useless and unproductive, an area which is increasing by over 250 acres every year, you will realize that these ravines are an ever-increasing menace. Gradually they extend into the fields till they also become useless ravines and whole villages have been swallowed up in the general destruction. Look again at the devastated areas of the Hoshiarpur *chos* in the Punjab where between 1854 and 1897 nearly 50,000 acres of land was overrun by torrent beds. The land value of villages in the Hoshiarpur and Jullundur districts decreased by 20 lakhs of rupees between 1884 and 1897. Now, although the flooding and erosion of these places is obvious to everybody, it is not always so obvious that this is happening in a minor way over very much larger areas. Even the damage caused below the Siwalik hills of the Punjab and among the Etawah ravines, though it must be checked by local work, has its origin miles away in the deforested Himalayan mountains. If the headwaters of streams are covered with properly managed forests, the monsoon rain is caught first by the leaves, then gently drifts to earth and is slowly absorbed by the sponge-like mass of damp vegetation which covers the ground. It slowly seeps into the various streams, the beds of which are large enough to drain it all away for use in the plains. But where these same areas are bare and deforested the water runs off at such a pace that the rivers become over-full and eventually flood and devastate the country lower down. Thousands of tons of soil are washed away and lost.

Erosive power

But there is a further danger. People do not realize the immense carrying power of water. A stream flowing at two miles an hour may carry along a stone of the size of a chicken's egg. Double the rate of that flow to four miles an hour and it would carry stones as large as a football, while a torrent going at 20 miles an hour would carry along a rock weighing 3,000 maunds. And even that is not all. If a stream travelling at two miles an hour can grind and wear away the land (erosion) at a certain pace, then the torrent of 20 miles an hour will have one hundred times the erosive power.

So you have a vicious circle on the deforested hillside. The flood increases the carrying

power and the increased carrying power further increases the scour which deepens the beds, increases the slope and further increases the velocity, and so it goes on. It is the lowering of the bed of the Jumna by the scouring power caused by the floods of the deforested Himalayas and the increased drainage of the Jumna which eventually formed the Etawah ravines.

If, therefore, the farmer is to protect his homestead, he must always be on the watch for the beginnings of floods and erosion on his own land. Because he will suffer from the floods caused by the deforestation of catchment areas, and especially mountain catchment areas, perhaps hundreds of miles away, he should see to it that no part of his native land is abused.

It is an axiom in many civilized countries that the high level catchment areas of rivers must be kept afforested. In parts of Europe the law is such that nobody, whether the state or private owner, may deforest the high level catchment areas.

Handmaid of agriculture

Forestry has often been called the handmaid of agriculture. This is even more true of a country of extremes of climate like India than of the more temperate European climates. Europe can stand the misuse of land without the terrible retribution which follows in countries like India, China or the southern portion of the United States. If those countries are not to lose their most valuable asset, namely their soil fertility, they cannot afford to forget the great influence that forests wield. The abuse of land culture, which after all is the farmer's job, will bring in its train as terrible a punishment as has overtaken those who dwelt in the ravine lands of Etawah where, it may be remembered, there once flourished a *sal* forest.

THE DESERT EDGE OF INDIAN AGRICULTURE*

By W. Burns, C.I.E., D.Sc., I.A.S.

Agricultural Commissioner with the Government of India

IN all spheres of human action extreme climatic conditions present problems of scientific interest and practical importance. This paper deals in the main with the problems and potentialities of agriculture in that large tract of country which divides the great plain of the Indus from the Gangetic plain; in other words, with the dry areas of Rajputana and the adjoining and comparable parts of Sind and the Punjab. In the main, this great tract produces crops dependent on rainfall alone, of which the *kharif* (or monsoon) crops harvested in the autumn are the more important. Here the main difficulties are:

(1) delay in the commencement of the monsoon which results in late sowing and consequently reduced yields;

(2) post-monsoon drought which has a bad effect on the ripening of the crops, particularly such as happen to be late maturing;

(3) long intermittent dry periods during the growth of the crop which cause cessation of growth and seriously impair the size and yield of the plants.

In the production of the unirrigated *rabi* (or winter) crops the characteristic difficulties are:

(i) poor germination due to lack of moisture in the surface soil at the time of sowing;

(ii) Droughty conditions during the whole life of the crop.

Dry-farming

Dry-farming methods suitable to tracts where the average rainfall is 20 in. per annum need to be modified if they are to be applied to areas characterized by a rainfall of 15 in. or less and by great heat with dry winds. There are dry-farming research stations at Sholapur and Bijapur in the Bombay Province, Hagari in the Madras Province, Raichur in the Nizam's Dominions and Rohtak in the Punjab. At all these stations except the last the annual average rainfall is of the order of 20 in. and the soils are non-alluvial. At Rohtak the average annual rainfall is 16·41 in. and the soil is alluvial. Rohtak is just within the desert area, and is situated in a part of the Punjab which in recent years has been subject to famine on account of failure of rain, particularly in 1938 and 1939, in which years the rainfall at Rohtak was 8·24 and 10·20 in. respectively. Even in 1940, with a rainfall of 16·96 in. up to the first week of October, the September rainfall was unsatisfactory, amounting only to 1·09 in. received in a single shower at the end of the month.

The object of dry-farming, for this or any other area, may be defined as 'to catch, hold and use all the rain that falls'. In the arid areas of Rajputana and other parts of north-west India, the attainment of this object presents the following difficulties:

(*a*) Not only is the average rainfall low but only 8 to 10 in. of rain can be expected in a bad year.

(*b*) The farming system must be such that both large and small individual falls of rain can be dealt with and long irregular intervals between showers tolerated.

(*c*) There are strong winds.

In areas of this type, the importance of the cultivated fallow as a moisture-conserving measure cannot be over-emphasized, and

*Synopsis of a paper read, in the absence of the author, by Sir Bryce C. Burt, C.I.E., Director of Animal Feeding Stuffs, Ministry of Food, at a meeting of the India and Burma section of the Royal Society of Arts, at John Adam Street, Adelphi, W.C. 2, on Friday, 25 April 1941. Sir John Russell, O.B.E., D.Sc., F.R.S., Director of Rothamsted Experimental Station, presided.

experience at the Rohtak Dry Farming Station is illuminating on this point, the yields of grain of early small-grained *bajra* in 1939 with a rainfall of 10·20 in. being 403 lb. after fallow but only 29 lb. after a crop.

Scope for tractor cultivation

Soil management being of primary importance, it is worthy of note that in these vast desert areas there is scope for tractor cultivation in the clearing of trees and scrub, in the making of ridges in the first preparation of new ground, and in such tillage practices as sub-soiling to permit of deep penetration of rain water without the subsequent loss by evaporation which inversion would cause. There is considerable scope for the improvement of bullock-drawn implements, especially by the importation of ideas or designs from other parts of India. For example, on the farm of the British Cotton Growing Association at Khanewal, Sir William Roberts, in the early days of the farm, introduced from the Deccan some bullock-drawn implements which he had modified to suit local conditions. These give excellent results in that part of the Punjab. There is no reason why the three-coultered seed-drill, set for the wide spacing demanded by dry-farming methods, should not replace the single tube fixed on to the back of a country plough. But this in turn presupposes a tillage implement capable of producing a seed bed in which the three-coultered drill can work. As ridge-making implements suitable for bullock power are required, it would be well worth experimenting with such '*bund*-formers' as the one invented by Mr Charley, recently Agricultural Engineer at the Coimbatore Agricultural College in Madras, which costs only seven rupees. Larger ridges or banks can readily be constructed with tractor-drawn implements and permit the use of another method of conserving rainfall which is well understood in some parts of India, namely, the production of crops on a considerable area below a bank, the subsoil moisture being maintained by seepage from above the embankment which checks the run-off. The author has seen one such area in Jodhpur where, on rainfall of only 2·25 in., 20 acres of land so situated had matured a three-foot high crop of the Great Millet, *jowar*, whilst the crops on an adjoining area of 210 acres had perished. The stabilizing of *bunds* by suitable vegetation in an area subject to wind erosion is another matter requiring investigation.

What to grow

Assuming a satisfactory method of land treatment and a suitable crop rotation, the next point is the choice of varieties of the crops to be grown. This is important. One may say generally that the main desiderata are earliness and what, for want of a better word, we may call toughness. This characteristic toughness one may expect to find in varieties which have been selected in areas which are themselves of the desert type. Such choice of varieties is no less important in arid climates even when irrigation is practised and several examples have come to notice under Canal Colony conditions. Perhaps the most striking is the behaviour of the variety of cotton known as Sanguineum 119, selected by the Punjab cotton breeders from *Gossypium sanguineum* in the neighbourhood of Multan in the Punjab, a place of extreme heat and drought. In the season 1939, 49 varieties of cotton, grown with irrigation, were tried at Ganganagar in Bikaner State. The outstanding success was Sanguineum 119 which gave yield of 798 lb. of seed cotton and 313 lb. lint per acre, whereas Punjab 289/43F gave only 594 lb. seed cotton and 184 lb. lint, and Punjab 289D gave 566 lb. seed cotton and 181 lb. lint per acre. Plant counts showed that the higher yield of the Sanguineum was due to its high survival rate, which was two-and-a-half times that of the 289F types, resulting in a much larger final stand of plants. Although the 289F cotton fetched a price 33 per cent above that of the Sanguineum, the latter crop was worth Rs. 76-8 per acre compared to Rs. 63-2 for the 289F.

In Sind, after years of trial, success has been obtained with the acclimatized American type Sind Sudhar which was selected in Sind from Punjab 289F and which possesses this quality of toughness, or ability to stand up to the conditions of its environments.

Earliness important

For crops depending on rainfall earliness is more important than when irrigation is available. The following is a striking example. As a result of famine conditions in 1938 and 1939 the stocks of seed of *bajra* in the Rohtak district of the Punjab were heavily reduced. Seed was imported from the adjoining Gurgaon district and sown in 1940. The September rains were deficient and, being a later variety, the Gurgaon *bajra* did not head out satisfactorily, whereas the earlier local Rohtak variety did so and matured a crop. Similarly in the Rohtak district Mollisoni cotton, if sown on the winter rains in March, will ripen in October, but a later cotton would not be able to do this. For this area the Punjab Agricultural Department recommends a list of selected hardy and drought-resisting types of gram, barley, wheat and *sarson* for *rabi* sowing and of *jowar*, *bajra*, *guara* (*Cyamopsis psoralioides*) and *moth* (*Phaseolus aconitifolius*) for *kharif* sowing. Much, however, remains to be done for the great Rajputana tract. It may be possible to use some of the dwarf types of various crops which have been naturally selected in other drought-stricken areas, such as the dwarf maize grown by the Navajo Indians in America. This is always assuming, of course, that there would be no difficulty from the variety being suited to another length of day. This question of length of day has proved a stumbling block in the introduction of *jowar* types from one part of India to another with markedly different day-length conditions.

Grassland management

Given a retentive soil and a moderate amount of rain, many of the desert areas will grow excellent grass. The author has found five good species in one of the many grassland areas, known as *jors* in the Jodhpur State. A good deal could be done by working out systems of management for such grasslands, which should include measures to keep down useless vegetation, especially thorny shrubs, and to prevent the packing of the soil, also measures for the reseeding and replanting of denuded areas with good species, and the devising of schedules of cutting and grazing. At Palri in Jodhpur, stumps of the best local grass *Dichanthium annulatum* were planted, three feet apart, in lines five feet apart, in 1937. The two following years were famine years and yet the planted area not only survived but gave a yield of about 930 lb. dried grass per acre on 8 in. of rain. In a good year four times this yield would be obtained. An area sown with seed of this species was equally successful. This grass (which used to be called *Andropogon annulatus*) is widely distributed and greatly valued over western, central and northern India.

In desert areas another immediate need is organized effort to develop plantations of fodder trees and the working out of a scientific system of lopping.

Fodder trees

Mention should here be made of the system of irrigated fodder tree plantations common in Sind, especially in the non-barrage areas of Lower Sind. The tree used is *babul* (*Acacia arabica*) the bark of which is an important tanning material. Such plantations often arise naturally from seeds which have passed through browsing goats, and are really naturally occurring groups of trees which have been protected. But in many instances the *babul* seed is broadcast with seed of *jowar* or *bajri* or is sown in lines 30 ft. apart within a crop of *jowar* and *bajri*. The cereal crop protects the seedlings from camels and goats in the first stage. After the grain crop is harvested the *babul* seedlings make rapid growth and require no irrigation till the next *kharif* season, when two or three floodings to a depth of about 6 in. are enough and the plantation is fenced. Lopping can start about the fifth year and the plantation is usually cut out about the fifteenth year and the land taken back into ordinary farming, another plantation being started elsewhere. Given a good start, *babul* trees will survive and grow in conditions of very defective rainfall. At Hissar in the Punjab, Captain Read planted, in borrow pits, *babul* seed that had been soaked in liquid manure to soften the seed coat. No artificial irrigation was given and the total annual rainfall in the four succeeding years was 9·23, 22·61, 6·22 and 9·66, the distribution being bad even in the year

of good rainfall, and acute famine conditions prevailed in the district, yet these trees lived. The characteristic fodder tree of Jodhpur (*Prosopis spicigera*), locally called *khejati*, is worth special planting and scientific lopping, especially as *jowar* is said to grow up to, and along with, this tree. Another fodder tree, the mesquite (*Prosopis juliflora*) has been introduced into India more than once in the last thirty years. It is bushy and as it has large spines the branches are not useful as fodder, but it yields a crop of edible pods. Since it tolerates alkali it should find a place in a desert fodder programme. Citrus fruits grown in arid areas, particularly the grape fruit, suffer badly from sun scorch, which might be avoided by the interposition of lines of leguminous trees giving broken shade. The use of shade trees is familiar in tea and coffee plantations and this practice might have possibilities in fruit plantations in arid regions when irrigation water is available and there is no question of competition for soil water.

Subsoil irrigation

In a really arid part of the world, any means of economizing water is worth consideration, and some interesting private experiments have been carried out at Mayo College, Ajmer, by Lieutenant-Colonel G. Howson, C.I.E., M.C. The inspiration for this work came from a leak in an underground water-pipe giving less than a pint a day which kept alive a circular patch of *dub* grass (*Cynodon dactylon*) throughout a very hot dry weather. Other observations included vegetation consisting of grass, weeds and a luxuriant vegetable marrow maintained by a small leak in a main 15 in. below ground level. Lieutenant-Colonel Howson then tried subsoil irrigation, using three-inch kiln-baked earthenware pipes made by the local potters at a cost of about two annas a foot. These pipes were tapered slightly at one end and the joints were left without packing. They were laid at the bottom of trenches 15 in. deep. There were at least 30 different experiments, large and small. The method has many obvious advantages, of which the following may be mentioned :

(*a*) evaporation from the soil surface is almost entirely eliminated ;

(*b*) surface rooting weeds have little chance of establishing themselves ;

(*c*) a given amount of water can be made to cover much more ground than by surface watering ;

(*d*) the water is delivered in the root zone of the crop.

Preliminary rough estimates indicate that subsoil watering would use perhaps only a tenth, and certainly not as much as a fifth, of the amount of water normally applied in surface irrigation. The land above these sunk pipes has been ploughed without damage to the pipes and with great ease on account of the softness of the damp soil. Lieutenant-Colonel Howson has since found that this system works equally well in another part of India on medium black soil with a fair amount of clay in it.

Need for desert laboratory

It needs little imagination to see what possibilities exist for the work of the pure scientist in these desert areas. Various botanical surveys, combined with ecological observations, have been made and there are meteorological records from certain stations in arid areas. The research on the Desert Locust, financed by the Imperial Council of Agricultural Research, included work on the animal and plant ecology of the desert tracts in which the locust breeding grounds are situated. The investigations have now been closed and the results are in course of publication. But India has no desert laboratory like that in Tucson, Arizona, where the fascinating problems of the relations of the plant to water can be studied in natural arid surroundings. The establishment of such a station is overdue, and the staff engaged at it could collaborate fruitfully with agricultural scientists engaged in solving the practical problems of desert agriculture and fodder production, and with the staff of the Locust Warning Service, directed from the Imperial Agricultural Research Institute at Delhi, which has been established as the result of the research work referred to above.

There are many points which have not been touched on in this paper such as the fixing of dunes, the establishment of windbreaks,

and the treatment of alkali land. In conclusion, one may be permitted to express the hope that pure science and practical ability, imagination and inventiveness will surely in time fulfil the prophecy which says: 'The wilderness and the solitary place shall be glad of them, and the desert shall blossom as the rose.'

SCIENCE IS NOT A THING APART

THERE is no peculiar 'holiness' in science, and they do it a disservice who assert that science is something mysterious which cannot be comprehended by the ordinary citizen. To eliminate jargon and promote the effective exposition of what science is doing is one of the first duties of the man of science and one of the greatest safeguards of freedom of thought in a democratic society.....Scientific workers must learn the art of cooperation with their fellow citizens, of interpretation and exposition, of spreading a scientific outlook and approach to the problems of society and of world order, abandoning all claims to be a class apart, without surrendering that higher loyalty which bids them follow wherever truth may lead them.—*Nature*, 10 May 1941.

RECLAMATION OF *USAR* LANDS AT BILANDA

By Bishan Mansingh, B.A.
Bilanda Farm, Fatehpur, United Provinces

SOMEHOW the term '*usar*' has come to be applied to every kind of unproductive land, and many large tracts of land which could be made productive with a little effort and expenditure have been left as hopeless. One characteristic common to all kinds of unproductive land is that it has become impermeable and very hard on the surface by being beaten under the feet of countless hungry cattle roaming over them for ages.

Usar land, as generally found in our province, is made up of deep layers of stiff, heavy, poorly aerated clays, devoid of all humus and containing salts in injurious amounts with the result that no vegetation can thrive on it.

Very bad *usar* land is covered by a brownish-white substance known as *reh*. Such lands are found mostly in the canal tracts due to the effects of perennial irrigation. Another kind of bad *usar* land is found covered by black incrustrations. My method of reclamation is the same for all kinds of *usar* land. The worse land of course takes longer to improve.

The first step

In order to make *usar* land fit for the growth of vegetation the injurious salts should first of all be removed from the soil. The strong solution of salts in the soil draws water from the plants instead of passing it on to them and under such conditions the plants naturally die of drought.

After reducing the injurious quantities of salts in the soil, the land should be opened up to a depth of from 6 to 8 ft., made permeable and friable, and sufficient quantities of humus added to it. In the absence of humus in the soil the bacteria which collect nitrogen from the atmosphere cannot thrive and no regular supply of nitrogen in the soil will be available for the growth of the plant or any vegetation. In order to ensure the presence of bacteria in the soil, a few basket-loads of dry earth from *arhar*[1] and gram fields should be scattered on the area proposed for reclamation. Humus brought down by rain-water and the dried roots of the vegetation over the area will provide food for bacteria.

The only cheap way of opening up the soil to a depth of 6 ft. and more is to plant trees or shrubs having tape roots such as *babul*,[2] *madar*,[3] *jharberi*[4] and *kans*.

The following history of the Bilanda Farm will clearly show how this method of *usar* reclamation was carried out there and what are the results so far.

Accidental discovery

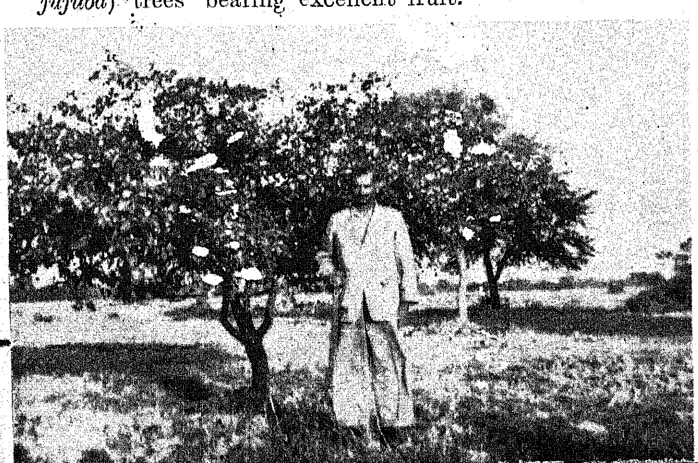
It was in the late nineties of the last century that my father, the late Rai Ishwar Sahai Bahadur, started cattle-breeding in his Habeeb Farm with a dozen good *desi* cows and a Hissar bull imported from the Punjab. When the herd began to grow, he felt the necessity for cheap fodder and a regular grazing ground for the herd. In order to provide these he utilized *usar* land. About 19[illegible]3 he selected a fairly big plot of *usar* land in his village, Bilanda, entered in Government village papers as *ghair-mumkin*[5], about one square mile in area, dotted here and there with a few fields of very poor soil. First of all he surrounded the selected plot with a low embankment only 1 ft. × 1 ft., more with the object of demarcating the selected area than for holding rain water as till then he had no idea that the presence of salts in injurious amounts in the soil would not allow any vegetation to thrive on it. Nevertheless, the presence of low embankments partially served the purpose of washing away

[1] Pigeon-pea: *Cajanus indicus.*
[2] *Acacia Arabica.*
[3] *Calotropis* sp.
[4] *Zizyphus jujuba.*
[5] Waste land.

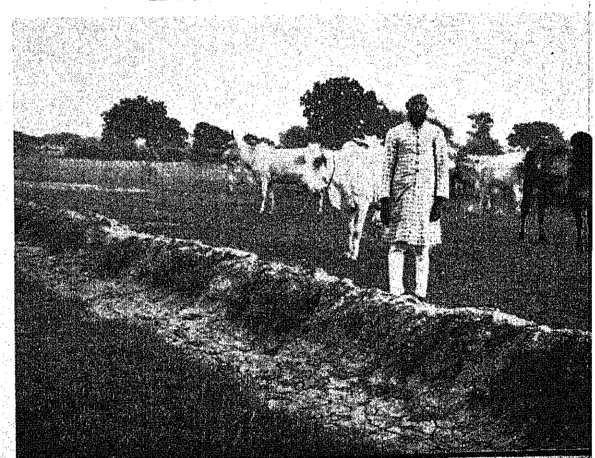
Bikka paddy crop grown on reclaimed *usar* plot at the Bilanda Farm, Fatehpur.

The author standing in of barley on recently reclaim land. This is a second cro paddy.

Mr Bishan Mansingh, owner of the Bilanda Farm, standing beside one of the grafted *ber* (*Zizyphus jujuba*) trees bearing excellent fruit.



Herd of cattle at the Bilanda Farm.



the injurious salts from the soil. The low embankment was as frequently repaired as it was broken by the cattle. Gradually grasses of various kinds and perennial weeds, *kans*, *kusi*[1] and *jharberi*, began to flourish along with *babul* and *madar* plants. I do not remember how *madar* plants appeared there, but my father encouraged extension of this plant on the area as wherever it existed good grass surrounded it to the extent of 3 to 4 ft. on all sides. Grazing was regulated so that the grasses might thrive and the fodder be available for the cattle for a longer period.

Babul seeds were sown regularly during the rains every year, but the rate of mortality was excessive among plants of all ages. We could not account for the cause then (although now I can say that it was due to the presence of salts in injurious quantities in the soil), but we persisted in planting them year after year with the result that in about ten years we had a good *babul* plantation with a good undergrowth of grasses of various kinds and perennial weeds, which opened up the soil.

Protection from cattle

The land adjacent to *madar* plants quickly improved with good grass over it and the germination of *babul* seeds was also much better on the patches close to the roots. *Babul* seeds collected from the droppings of our herd germinated much better than the ordinary seed obtained from the trees.

Due to protection from indiscriminate grazing various kinds of useful trees are germinating and thriving on the farm without any effort on our part to introduce them. *Neem*[2] and *sheesham*[3] plants have developed on patches under the branches of *madar* plants and inside *jharberi* bushes. There are over 500 *neem* and 50 *sheesham* plants on the farm now. Their seeds were either brought by the wind or by the wild birds from the trees on the Grand Trunk Road which runs through my farm.

Jharberi, *kans* and kindred grasses steadily spread over large tracts simply because they were protected from cattle. *Babul*, *madar*, *jharberi* and *kans* are deep-rooted plants and their roots break open the soil to a great depth and thus expose the subsoil to the action of the sun and the air and make the adjacent land permeable.

Before 1916, while I was at college, my interest in this reclamation work was that of a keen observer, but from July of that year, when my college education was over, I began to work as an assistant to my father in all his agricultural activities.

Short-cuts to success

Though the reclamation of *usar* land by means of planting *babul* trees and regulated grazing was a complete success so far as fodder and grazing ground were concerned, it took a very long time and therefore we continued our efforts to find some short-cut to success. On one or two occasions large tracts of the farm were ploughed by inversion ploughs after the break of the monsoon, but it did not prove very useful. I am afraid it was otherwise as the breaking up of the surface of the soil interfered with the quick rising up of the injurious salts from inside the soil when it was under water.

By 1930 the waste land had apparently improved so much that we were encouraged to grow cereals over an area of 40 acres in the centre of the farm ; but here we failed, because *jharberi*, *kans* and kindred grasses would not let any crop grow on the land demarcated for cultivation.

By this time the drying up of grown-up *babul* trees had considerably decreased : still quite a large number of them used to dry up every year. The growth of self-grown *neem* trees was not good although they did not dry up. At one time we thought that the drying up of *babul* trees was due to *kankar* in the subsoil and had the subsoil dug up to a depth of 8 or 9 ft. at several places where *babul* trees had dried up, but we found no *kankar* underneath.

Importance of bunding

The most remarkable improvement came about 1934 when I introduced strong embankments with the object of washing away injurious salts from the soil and for holding rain-water

[1] A variety of weed very similar to *kans*.
[2] *Melia azadunettu*.
[3] *Dalbergia Sisso*.

for paddy cultivation over the area on which cereals had failed on account of over-abundance of perennial weeds.

A ditch 10 ft. × 2 ft. was dug on three sides around the whole area under reclamation and the excavated earth was thrown on the outer side of the farm so as to make a strong *bund* to hold rain-water. During the early part of the monsoon, i.e. up to the middle of August, collected water when slightly sticky was allowed to run off twice or thrice through a deep cut made into the *bund* and the *bund* was well repaired as soon as the stored water had escaped.

The fields were heavily manured with farmyard manure and paddy cultivation proceeded along with the washing of salts. Before puddling operations in paddy fields began, *kans* and *jharberi* plants were removed from the surface by means of large sickles called *jhabaus*. When water remained in paddy fields for long periods at a stretch, air could not reach the roots of *kans* and other weeds and they died of suffocation.

When the harvest was reaped in late October and early November, the yield was found to be very good, perennial weeds had quite disappeared and wide cracks were left all over the cultivated area. As a matter of fact all the land in the farm which was under water for any length of time was cracked rather deeply and thus opened up for the action of the sun and air. It is not necessary for me to emphasize their importance for the growth of plants and crops.

The following year I cultivated *jowar* and *arhar* crops on a few fields the surface of which was comparatively higher. The size of the plants and the yield were quite satisfactory. In 1938 I grew sugarcane over this reclaimed land, but the crop was only fairly good. This year too we have sugarcane on two fields. This is not satisfactory owing probably to the bad monsoon. Besides this I could not manure sugarcane crops with cakes and chemical manures.

Dhania[1] (a kind of spice) crop does very well on some fields.

In 1938-39 the monsoon was very good and I obtained a second crop of barley, gram and wheat after harvesting paddy crops and the yield was very encouraging. Last year the yield of paddy (*bakka*, a local coarse variety) reached 50 maunds per acre on some fields, but the yield of paddy this year was badly affected by the scanty rainfall. *Jowar* and *arhar* crops are excellent this year.

Compost used

As I have got a large herd of cattle on my farm I manure my fields very heavily every year with farmyard compost manure mixed with a light quantity of slaked lime to make the soil friable.

I observed another advantage of holding rain-water. It is that on low-lying areas *kans* and other coarse grasses that shoot up in luxuriant growth in the early part of the monsoon are slowly but steadily disappearing, giving place to very good quality of *ukar* grass which appears very late almost at the end of the monsoon and attains maturity by the middle of December. This grass is relished both by cattle and horses.

In 1936 I observed that in most of the *jharberi* shrubs regular *ber* plants had developed. The fruits were no doubt of very poor quality, but in great abundance. This fact suggested to me that plums would grow very well on this reclaimed land. I therefore cut down some of the old trees, leaving an inch of stem from the ground. When the new shoots appeared I selected the most vigorous ones and removed the rest. On these shoots I put on the buds of good quality *bers*. I have now over 200 plants of these grafted *bers*. The fruits are as good as of those from which buds had been obtained. They begin to fruit in the second year after grafting.

In 1937 I started a guava plantation on a commercial scale and now I have over 500 plants. The vegetative growth of the plants is very satisfactory and the fruits have good flavour.

Last year I planted about 60 grafts and 40 seed mangoes and so far they are doing very well.

Profit from trees

From 1917 we used to sell *babul* trees worth Rs. 500 on an average every year and in 1938 I sold all the big *babul* trees for Rs. 13,750. I hope the existing *babul* trees will now

[1] *Coriandum Sativum.*

develop more rapidly and fetch an equal amount of money after 10 or 15 years.

With so much cultivation and plantation the farm provides fodder and grazing for herd of over 100 head of cattle.

Out of a total area of about 300 acres I have brought only 50 acres under crops and fruit, because I believe that the need for pasture-land is much greater than for land for cultivation. It is much more economical and paying to obtain heavy yields from a small area by better cultivation and manuring than to have large areas under crops of poor yield.

Our existing fields are getting less and less productive for want of sufficient manure and irrigation facilities. Without enough pasturage we cannot even properly maintain our livestock, not to speak of increasing it, and if the cropped area is extended without proportionate increase of our pasture our limited supplies of manure and water will have to be distributed over a still larger area with the result that in our attempt to increase our cultivated area we will do just the reverse, i.e. we will turn our existing economically productive land into unproductive.

SECRET BIDDING IN THE COTTON TRADE

By

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and

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Of the various methods of settling rates, the cover system of bargaining appears to the ordinary observer to be the most interesting. Its interest lies mainly in the fact that negotiations for the sale of produce are carried out under the cover of a piece of cloth in an atmosphere, so to speak, of mystery. The actual procedure may be summarized as follows :

Bidding technique

On his arrival at the market the cultivator arranges for the sale of his produce through his *arhatiya* or commission agent. When a sufficient number of buyers have collected, the *arhatiya* takes them over to the cultivator's cart, where they examine the produce carefully by drawing samples from different parts of the lot. As each buyer is ready to bid, the *arhatiya*, holding the right hand of the former, covers it with a piece of thick cloth, and bidding follows by means of the manipulation of fingers. Depending on the basic price per unit of weight each finger represents a definite value. Thus, for instance, if the ruling rate of the commodity on a particular day is Rs. 8 per maund and an offer of Rs. 9 is to be conveyed, the transaction will be completed in two successive clasps. In the first, each of the four fingers will represent Rs. 2 while in the second it will denote only Re 1. In some cases, however, the bid may be conveyed in a single grasp. For instance, in a case in which an offer of Rs. 22 is to be made, the buyer may use only two fingers denoting Re. 1 each, Rs. 20 having been taken as the basic or the ruling rate of the commodity. Fractions of the rupee are similarly dealt with. In this manner, each buyer on the spot is consulted by the *arhatiya*, who finally communicates the highest offer to the seller. In the event of non-acceptance by the latter, the *arhatiya* repeats the operation until better offers are forthcoming from the buyers and the seller finally agrees to accept the bid. As a contrast to the practice of repeated bidding, the 'single bid' system is in vogue at some of the principal markets where a very large number of carts have to be disposed of in the course of the day. This differs from the former in that the offer, once it is made, is final, without any further consultations taking place between the *arhatiya* and the buyers. A considerable amount of time is thus saved and a comparatively larger volume of business gone through.

Distribution of the system

This system of bargaining obtains largely in the main cotton-producing tracts of the country. In some of the principal cotton markets of the Punjab, namely Lyallpur, Okara, Gojra, Jaranwalla and Amritsar, bidding is done under cover during the greater part of the year. At the time of heaviest arrivals in December and January, however, settling rates according to this lengthy procedure becomes more or less impracticable. Instead, a single rate on the basis of values obtaining at Bombay is announced to the assembled group of buyers. The individual buyers, however, may, in case of disagreement, make their own offers to the *arhatiya*.

Secret bidding is by no means confined to the Punjab. Prices of cotton are settled by this method in some of the cotton markets

of the Central Provinces and Berar. It is also one of the methods of settling rates in the United Provinces and Bengal where the system even extends to commodities other than cotton, such as food grains and oilseeds.

The system is also common in the Bombay market in respect of grapes imported from the Nasik district, and the same is true of grapes from other important grape centres, such as Quetta, Peshawar, Multan and Amritsar. Large consignments of eggs from upcountry are also disposed of by secret bidding between sellers and buyers at the Victoria Terminus, Bombay.

Advantages and disadvantages

One of the foremost drawbacks of this system lies in the lack of confidence it engenders in the mind of the seller on account of the secret character of the negotiations. The seller, it is often pointed out, remains a silent witness to proceedings which are ultimately going to lead to the disposal of his own produce. The *arhatiyar*, if he happens to be partially inclined towards one of the buyers, may, by ignoring higher bids, allow him to purchase stock at cheaper rates. This, of course, follows as a natural inference from the fact that bidders are totally unaware of one another's offers and that it is the *arhatiya* alone who knows the mind of all. Against this criticism may be advanced the very strong argument that the seller must be consulted and that until he is thoroughly satisfied the bargain cannot be closed. Yet, despite the fact that the ultimate decision rests with the seller himself, there is apparently no guarantee that the commission agent will, under all circumstances, be actuated by a sense of honesty and that the seller will be correctly informed of the range of bidding.

Important safeguard

To safeguard the interest of the seller, therefore, it is imperative that the highest bid should be openly declared in the presence of prospective buyers. This practice, however, exists in certain markets, as for example in the Central Provinces. Further, in all cover sales the buyer is usually inclined to state his maximum, since his sole criteria at the moment are his own requirements or the limits of his own financial backing. In other words, he does not stop to ponder over the bids of others and consider every anna before making the next higher offer. As compared to sales by auction, the cover system has a definite advantage in that it ensures a relatively speedy conduct of business, especially when large quantities of produce have to be dealt with.

No doubt that auction sales give rise to a sense of keen competition among the buyers and under such circumstances prices tend to rise steadily. Nevertheless, the maximum bidding capacity of a buyer cannot be exploited as long as he is conscious that the transaction might be closed at a lower rate. Incidentally, a sale by auction may not always prove to be favourable to the *arhatiya*. In auction sales, bidding is done by all kinds of buyers whether of sound or unsound financial means, and it is not unusual to find that in the heat and excitement of auction a buyer has made an offer beyond the limit of his resources. As a result, the *arhatiya*, who is committed to making full payment to the seller at the end of the auction, finds himself in a quandary, meeting with great difficulties in realizing his dues from the buyer eventually.

IMPROVED GHEE-MAKING FOR VILLAGERS

By Y. M. Parnerkar
Sevagram, Wardha

THE profits in the manufacture of ghee on a commercial scale depend to a large extent upon the degree of recovery of ghee from butter during the process of ghee-boiling. An investigation was undertaken with a view to finding a process which would give a higher yield of ghee and reduce the time of boiling and fuel consumption. The economic condition of the small ghee-maker in villages was kept in mind.

The usual method of ghee-making by villagers is to boil the butter in an open earthen or brass vessel on a cowdung fire for more than an hour until the crackling noise ceases and the curd is cleared. The vessel is then taken off the fire and the contents are strained through cotton cloth into another vessel and stored in a cool place.

In the present experiment the butter was melted by heating at 60°C., transferred to a vessel having a small hole at the bottom plugged with a bamboo peg and hung up in a cool open place overnight. Next morning, by removing the peg, the water and a part of the curds were run off, since the butter had solidified in the meantime. The whole was then transferred to another container and boiled gently to remove traces of moisture and precipitate the curd. From this point the process was the same as in the usual villagers' method.

Comparative trials yielded the following results :

Method	Butter (tolas)	Time to boil (mins.)	Fuel consumption (tolas)	Water and curds drained off (tolas)	Ghee yield (tolas)	Per cent of ghee from butter.
Desi . . .	120	39	7	—	90	75·0
Improved . .	120	26	3	15	100	83·3

In both cases the boiling was done on a kerosene stove using ordinary kerosene and the time and fuel in the improved method include that required for first heating. The quality of the product was practially the same in both cases.

It was observed that a clear solution was obtained during the draining when the atmospheric temperature was low.

There is a decided saving of time and fuel by using the improved method and about 8 per cent more ghee is obtained. The method is simple enough to be used in the samll-scale manufacture of ghee and to replace the *desi* method without extra trouble or expense except for the vessel with a hole in the bottom which should preferably be made from tinned brass.

GREEN MANURING

By R. D. Rege, B.A., M.Sc. (Bom.), Ph.D. (Lond.), A.I.I.Sc.

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In modern agriculture, green manuring is recognized as one of the important methods of application of organic matter to the soil for the maintenance of its fertility. It consists in the incorporation in the soil of plant materials of all kinds in the green or immature stage. Quickly grown crops chiefly of the leguminous order are also specially grown and ploughed in the soil before the succeeding food or money crop. According to Dobbs* the method of green manuring was familiar to Indian cultivators from time immemorial and had been variously embodied in agricultural practice.

Objects of green manuring

The cultivation of a green manure crop is undertaken for several very distinct purposes in farm practice. The most important purpose is to increase the humus and nitrogen content of the soil. In the temperate and cooler regions the increase in both of these can be accomplished easily, whereas in the tropical climate this is more difficult because of the rapid decomposition of the organic matter. This should not mean that green manuring has no permanent place in farm economy in the tropics. Merely its function will be different, consisting largely in the increase of the supply of assimilable nitrogen in the soil and in furnishing the soil with readily decomposable organic matter.

Green manure crops are also grown for protecting the soil against erosion and in conserving the nutrient elements, especially the nitrates, from being leached down during the part of the year when no other crops are grown in the soil. Further, green manuring is resorted to increase the water-holding capacity of a light soil and also to transform the phosphate and potash in the soil in an available form. It also exerts an important influence upon the activities of the beneficial soil micro-organisms and on soil tilth.

Application to India

These considerations apply more aptly to sub-tropical countries generally and to India in particular, as Indian soils are proverbially known to be poor both in organic matter and nitrogen, and also as there is a dearth of farmyard manure owing to the prevailing practice of using cowdung as fuel. Earlier experiments (1885-93) on green manuring at Cawnpore have in fact shown a very great increase in the yield of wheat in plots green manured with indigo, the increase amounting to nearly 50 per cent.

The primary consideration in choosing a green manure crop is that the plant should be able to enrich soil in respect of nitrogen and at the same time yield the greatest amount of organic matter. Leguminous plants because of their capacity to fix atmospheric nitrogen with the help of bacteria harboured in their root nodules have, therefore, attracted the greatest attention. A large number of them are used for the purpose, the most common being, sunn (*Crotolaria juncea*) and *dhaincha* (*Sesbania aculeata*). Sunn grows luxuriantly on light soils, while *dhaincha* is suited to heavy and also waterlogged soils. Cowpea (*Vigna catiang*) indigo (*Indigofera tinctoria*), *guara* (*Cyamopsis psoralioides*) and *mung* (*Phaseolus mungo*) are also used. Search is always going on for new plants, and at Padegaon a weed locally known as *patada shevra* (*Desmodium diffusum*) is isolated and is showing great promise. Among the non-leguminous crops the favourite green crop is *sawan* (a wild form of *Panicum miliaceum*). It is often grown with rice and after the rice

* Pusa Bulletin No. 56 of 1915.

has been harvested the green crop is buried in the soil.

Limiting factors

Although green manuring is thus well recognized as a necessary adjunct in farm practice, its use is restricted owing to certain limitations. Among these, water supply is important as it is necessary for both the growth of the crop and its decomposition after ploughing. Loss of moisture by transpiration is very considerable during the growth of the crop and has been shown at Woburn by Voelkar to be the determining factor in causing the failure of even a legume (vetches) as a green manure as compared with non-legume, (mustard), the greater loss of water from the soil during the growth of the former more than counter-balancing the addition of nitrogen. Similar results have been obtained at Pusa with sunn and *dhaincha* on the succeeding wheat crop, the failure of sunn being mainly due to the higher loss of water by transpiration. Thus, any shortness of rainfall after burying a green manure crop would not only affect the growth of the succeeding *rabi* crop by preventing proper decomposition of the green material but would also create a deficiency of moisture for the proper growth of the succeeding crop.

Secondly, the incidence of a marked hot, dry period of longer or shorter duration precludes the possibility of either growing or burying of a green manure crop during this period in the absence of costly irrigation. The only period in the year when it can be, therefore, grown is the monsoon ; but in tracts where the monsoon period is utilized for the growth of food or money crops it is unlikely to be economical to substitute a crop the use of which is merely to improve the land for the growth of another crop. Under such circumstances, a suitable rotation of crops of direct economic value must almost always be the primary consideration. Such a rotation, however, usually includes crops which do not utilize the whole of the monsoon period, and it is possible to grow a green manuring crop within this period, during which the ground might otherwise remain uncovered. On this principle Dobbs has classified as follows the economic crops for which green manuring would be possible.

(1) Rice transplanted when the monsoon is fairly established—usually about six weeks after the first monsoon showers.

(2) Crops like tobacco which are planted at the end of the monsoon and the cultivation of which prevents the maturing of the monsoon crop ;

(3) Cold weather crops as wheat which require the conservation of a considerable part of the monsoon rainfall for the production of a full yield.

(4) Sugarcane, jute and garden crops which are sown at the beginning of the hot weather and the value of which gives a peculiar position as regards manuring.

(5) Crops grown on irrigated land and which are thus to some extent independent of the monsoon.

Time of burying

The rate of decomposition of the green plant material and the nature of the processes involved will depend upon the stage of development of the crop. Too young a crop decomposes very rapidly, but there is the danger of the loss of nitrogen through volatilization as ammonia or by leaching of nitrates, the loss depending upon the nitrogen content of the green manure crop. Very little humus is also produced in this case. On the other hand, too mature a crop decomposes very slowly, in which case, not only is there no liberation of nitrogen, but some of the nitrogen of the soil is removed by the micro-organisms active in the decomposition processes. This may result in harmful effects on the succeeding crops although a large amount of humus is produced during the process. It is, therefore, important to bury the green material at the proper stage of its growth, when it contains a balanced proportion of available carbohydrate compounds to available nitrogen compounds. In most of the plants used for green manuring, this stage is found to coincide with the time when the plants are fully grown and just beginning to flower.

Successful green manuring

As the rate of the liberation of nutrient

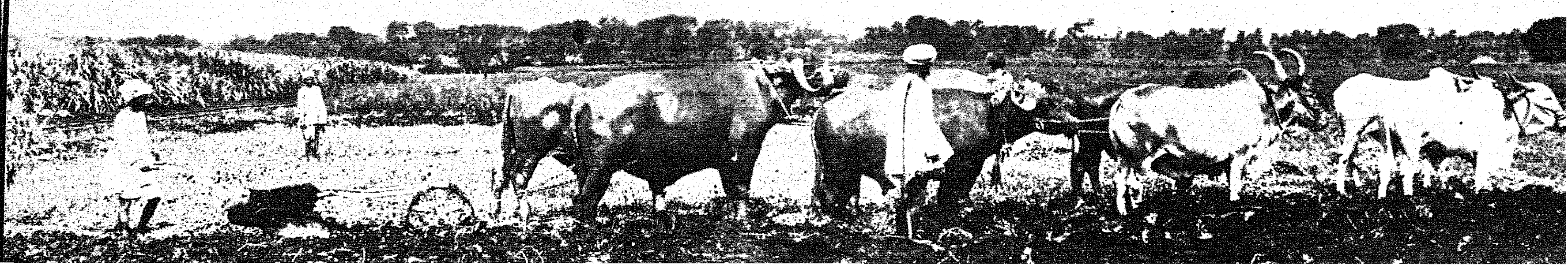
A new leguminous weed locally called *patada shevra* (*Desmodium diffusum*) found at the Sugarcane Research Scheme, Padegaon

[PLATE 137

Left: Sunn—green manure crop at Padegaon, ready for burying

[PLATE 138

Below: Burying of sunn in black cotton soil



POTATOES IN THE SIMLA HILLS

By Pushkar Nath, M.Sc. (Hons.) Assoc. I.A.R.I.

Superintendent, Potato and Wheat Breeding Sub-Station, Simla

SIMLA is well known as the summer capital of the Government of India. Few people, however, are aware that it is an important centre for the supply of potatoes to the plains of India.

Clustering round Simla are a number of hill states. Some of them, especially those situated to the east, send large quantities of potatoes to Simla, where they are stored, sorted, packed and despatched. Simla thus constitutes the clearing centre for all the produce which pours into it during the months of September, October, November and part of December. It may come as a surprise to many that Simla alone exports annually potatoes worth more than ten lakhs of rupees.

Source of supply

Simla itself has an area of about six square miles out of which only a very small proportion is under cultivation and the total production of potatoes hardly exceeds 2,000 md. Situated on and along the Hindustan-Tibet road—the 'life-line' connecting Simla with the interior—are a number of small hill states which are important sources of potato production. Of these Keonthal, Koti, Theog, Madhan, Kumarsein, Khenati, Ghund and Balsan deserve special mention as on account of their proximity to Simla the potato crop is their only money crop. Other states like Jubbal, Bhajji, and Rampur Bashar, and the Kotkhai and Kotgarh tehsils of Simla, also make their contributions, but because of the prohibitive cost of transport their exports are small. Kotgarh is famous for its apple orchards where the varieties Golden Delicious, Red Delicious, Royal Delicious, '*ras* pippin' and King of the Pippins are grown.

The first group of states consists of small, rough mountainous tracts, each varying from about 9 to 116 square miles in area. All the eight states put together do not exceed 392 square miles in area of which about 77 square miles or about one-fifth of the total is cultivated.

Soil and manure

The soil is variable but is generally stony loam intermingled with clay in some tracts. The small, terraced, sloping fields overhanging the various *khuds* and *nallahs* are generally fertile. Irrigation is often available in the lower plateaux, but the higher tracts, where potatoes are mainly planted, are usually not irrigated. Monsoon rains supply abundant water for the normal growth of the crop. The only source of manure is the half-fed local breed of cattle. On account of scarcity of manure and poor cultivation the yields are usually extremely low.

Unlike the plains where it is a *rabi* crop, the potato is grown as a *kharif* crop in the hills and planting is done during the month of April. It takes about five months for the crop to mature and by the end of September it is ready for harvest. Harvesting proceeds slowly and is generally completed by the end of November.

Cut seed-pieces are planted in furrows made with a plough. The plough also helps in harvesting operations, ploughing under the ridges exposing the potatoes which roll down the slope. Those that remain hidden are then exposed with the help of the *khilna* (pick). The produce is collected in small baskets and carried away in *kiltas* (large baskets).

Varieties

Great confusion exists regarding the varieties grown. The commercial grades *lambri*, *phool* and *rashan* exported under the one common name of hill or *pahari* potatoes usually consist of a mixture of varieties as explained below.

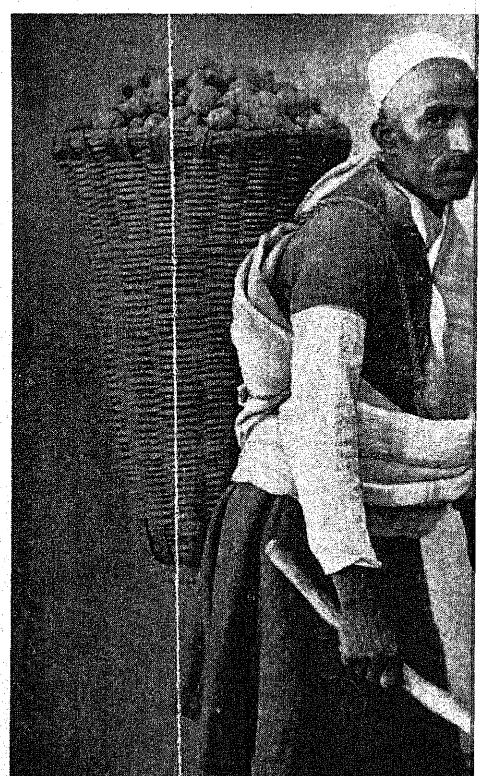
Lambri.—In this grade are included large-sized oval potatoes, varying between a quarter of a pound and one pound in weight. This

Bags of potatoes being carried to the goods sheds

[PLATI

Typical hill cultivators : Note the plough used for harvesting potatoes

The potatoes are carried in a *kilta* while *khilna* used for digging is in his han



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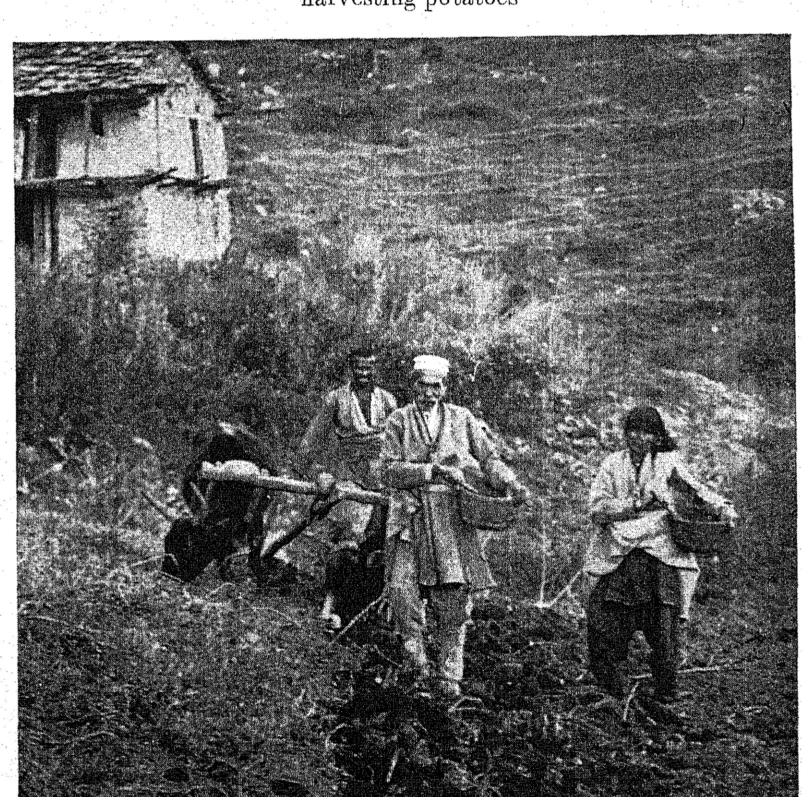
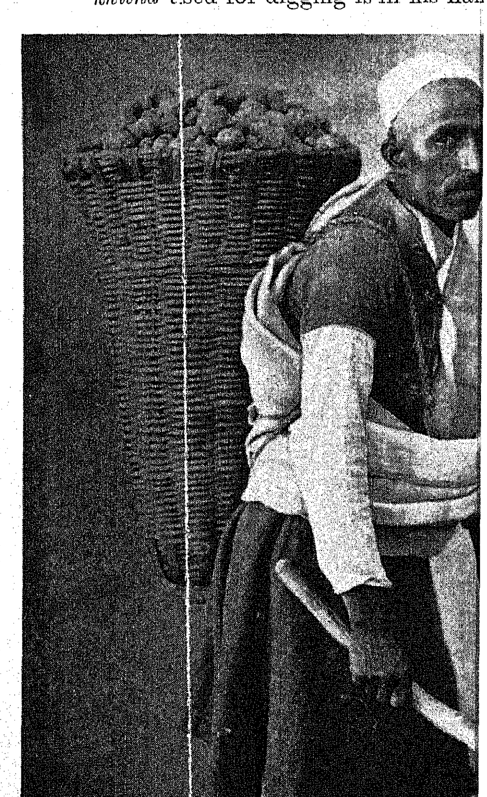




ugh very large quantities have to be weighed,
e ancient method of weighing still prevails

Thousands of bags accumulate at the Simla railway goods shed

[PLATE 140

Bullocks used for transporting potatoes halting at Matiana

is almost wholly composed of the well-known English variety, Up-to-date (synonym= Factor). Recently introduced, this variety gives excellent yields. It has, however, declined in popularity because of its poor keeping quality and taste.

Phool.—This grade consits mostly of medium-sized, bluntly oval potatoes, the majority of which belong to the European variety, Magnum Bonum. *Phool* potatoes, have excellent keeping and cooking qualities and also good flavour. They fetch the highest price in the market.

Rashan.—The residue, i.e. all the small tubers, damaged or otherwise, left after the selection of *phool* are included in this grade. The smallness of size of the tubers is responsible for the low prices paid for this grade.

A fourth grade, *gard*, is the unsorted mixture.

Excepting perhaps *lambri*, the other three grades are a composite of a number of botanical varieties which in addition to those already mentioned appear to include the *phulwa* and *gola* varieties which are grown extensively in the plains. There are also a number of other varieties which seem to have been grown in the past and are now found only as mixtures. As to how these varieties were introduced nothing definite is known. The potato has been under cultivation in the hill states for more than half a century. Enquiries show that the original potato was round, white and smooth. This had to be discarded as after cultivation for a number of years it yielded crops of numerous small-sized tubers only. This may have been the old *phulwa* variety still popular in the plains. Magnum Bonum, which represents the bulk of the *phool* potatoes, was probably introduced by European enthusiasts about 30 years back. It is interesting that during the Great War there existed a factory at Narkanda for the conversion of potatoes into starch which was exported as a food for troops on active service. Long oval tubers, which could be easily handled and sliced, were preferred for this purpose. Up-to-date is a recent introduction made by the Punjab Department of Agriculture. Some of the other varieties now found as mixtures were perhaps introduced by the zemindars themselves.

Communications and transport

Very few facilities for marketing the surplus produce are available. The Hindustan-Tibet road (with its subsidiaries), which traverses these tracts, is the only important road maintained by the Public Works Department. Although motorable for a distance of about 50 miles, only a few specially permitted cars are allowed to use it. To enable the road to be kept in good order a separate mule path has been constructed at places. Internal communications from village to village and from *chak* (estate) to *chak* is by narrow tracks, often unsuitable for mule traffic and fit only for cooly transport.

Transport is by means of man, mule or bullock. In places where no proper roads exist, man is the only source of transport. Within a radius of 10 to 15 miles from Simla the zemindars themselves carry and market their produce. Over 2,000 mules are engaged every year for transporting potatoes from September to December. The mule owners are by no means all local zemindars or *banias*. In fact, most of them are *kumhars* of the Punjab, chiefly from the Hoshiarpur, Ludhiana and Ambala districts. After three or four months of active business they migrate down to the plains. The bullock owners, like the mule owners, are outsiders from Suket and Mandi states. Because of the lower cost of maintenance, transport by bullocks though slower is cheaper than transport by mules. The bullock owners usually camp at convenient places where some flat land for camping and grass for bullocks are available; the latter are let loose to graze along the mountain side. At places where no such facilities are obtainable the whole herd is looped on to a long common rope.

The cost of transport is high, being about nine pies per maund per mile. Thus transport of a maund of potatoes over a distance of about 40 miles will cost between Re. 1-12 and Rs. 2. The price of potatoes, though controlled by the Simla market, varies in direct proportion with the rate of transport. A maund of potatoes selling at Rs. 3-8 at Simla will be priced at Re. 1 or Re. 1-4 at a place about 40 miles in the interior.

Exports

Exports from each state cannot be assessed accurately. No definite data regarding the area under potatoes and the total produce is available. Taking all the states as one unit, the export figures for the last four years are:

	Md.
1936	356,179
1937	329,907
1938	313,093
1939	362,836

About three and a half lakhs of maunds are exported from Simla alone. Every day thousands of bags reach and accumulate at the Simla railway goods shed and during the harvest months an average of about 4,000 md. are railed down in special wagons every day. As already mentioned, Simla alone exports potatoes worth about ten and a half lakhs of rupees annually. Including the exports from other states which send their supplies to the railway station nearest to them on the Simla-Kalka section, it may safely be said that this railway clears potatoes worth about 20 lakhs of rupees annually.

Receiving centres

It is a matter of surprise that except for some consignments for Meerut and Delhi almost all the produce is exported to distant areas like Bengal, Bihar and the Central Provinces. Bengal receives the major share, mostly through Howrah. Bihar and Orissa, which get their requirements through Gaya, Puri, Patna, Digha Ghat, Bhagalpur and Dinapur, are the next largest consumers. Supplies intended for the Central Provinces are booked mainly to Jubbulpore. The Central Indian states, like Ratlam, Indore and Ajmer, also depend on Simla potatoes. Karachi receives some of its requirements from Simla. Due to the total stoppage of the import of Italian potatoes, Bombay has also been listed this year as one of the receiving centres.

Difficulties

No organized Agricultural Department exists in any of the states and much depends on the local *bania*, the rich man of the village. He fixes rates, buys the produce and later disposes of the accumulated stocks at opportune moments. Due to the lack of adequate transport facilities, the cultivator, who except for his potatoes has very little to sell, is unable to arrange for the disposal of his small surplus and has thus to depend on the *bania*. He has to be content with the small sum the *bania* may offer; for his disfavour is a hardship which it is difficult for the cultivator to bear.

Prospects

There is little doubt that Simla and its neighbouring states constitute a very important source of potatoes for use in the plains. At present the serious lack of adequate transport facilities restricts the cultivation of this crop. With improvements in transport, both the area and yield per acre are bound to increase. The old varieties, which have no doubt deteriorated, are giving extremely poor yields and at present there is a great need for an improved variety which will yield well and possess good keeping quality. The Simla Potato Breeding Station, where extensive work on breeding high-yielding and disease-resistant varieties is in progress, will be in a position to give out in the near future varieties which it is expected will prove to be superior to the existing ones.

If utilized for industrial purposes, the potato can yield potato starch, flour, dextrine, glucose, dextrose, alcohol and lactic acid. There are a number of other possible uses also for the potato, for example starch production for laundry, manufacturing or edible purposes.

ANIMAL HUSBANDRY IN ANCIENT INDIA—II

By A. KRISHNASWAMI, G.M.V.C.
Civil Veterinary Department, Madras

THE realization in ancient India of the indispensability of the animal kingdom to human beings and the necessity for looking after the animal creation with the greatest care and caution is well borne out by the consecration of animals to gods and goddesses, as well as by the deification of animals, and their being placed on a par with the divine, as enjoined in the Vedas. These form the two important features of the Hindu religious system, and have left their mark on the literature, sculpture and architecture of ancient and medieval India.

Cow-killing forbidden

As early as in the Rig Vedic times, there was a school of thinkers who protested against killing such a useful animal as the cow. This is evident from the name *aghnya* (that which should not be killed) applied to the cow in many passages of the *Rig Veda*. In the *Brahmanadhanmika Sutta* of Sutta Nipāta, Buddha emphasizes the usefulness of the cow and strongly protests against cow-killing. This protest gradually increased in volume till the custom of cow-killing was totally abolished in a later age. By the Sutra period, the cow had already attained a peculiar sanctity. In the *Matsya Purana*,[1] the earth is represented as taking the form of a cow, and the worship of a cow[2] is enjoined. Apasthamba[3] says that one should not stretch out his feet towards a cow. Manu[4] says that the cow-pen is a sacred place. Wilful killing of a cow was considered so serious an offence that the killer was to be punished by mutilation. In *Apasthamba Samhita*,[5] *Parasara Samhita*[6] and *Agni Purana*[7] it is ordained that even if one killed a cow accidentally or happened to be the indirect cause of its death, one was to undergo a very severe penance. In Kautilya's *Arthasastra*, the law laid down in this respect is even more drastic.[1] It is enjoined that whoever hurts or causes to hurt, steals or causes another to steal a cow, should be slain. *Brihaspati Smriti*[2] lays down that persons suspected of stealing cattle should be subjected to the ploughshare, and if the guilt is proved, they should be severely punished. The ordeal itself was so severe that it certainly had a most salutary effect upon all those of questionable character. On the other hand, any act conducive to the well-being of cattle was highly commendable. In the *Ramayana*, we find that the cow Kamadhenu was the sole cause of the life-long conflict and struggle between the sages Vasistha and Visvamitra. Such was the veneration for the cow in ancient India.

The bull has been deified in the Hindu religion: it is the animal ridden by the god Siva and is considered to be his emblem. The importance given to it is such that there is no Shivite temple without the emblem of a bull.

Horses and elephants

As regards horses and elephants, we are in a position to say that there is practically no literature in ancient India wherein a reference to the greatness of horses and elephants has not been made. It can thus be seen that the ancient Aryans had always developed a tender solicitude for the care and welfare of these animals. And in the face of such a kindly feeling, it is no wonder that they were a practical set of people, and had laid down specific rules and regulations for the construction of stables and cow-sheds, keeping and employment

1 Chapter XI verse 12.
2 Chapter 80.
3 *Sutras*, 12, 20, 21 and 30.
4 Chapter IV, 45.
5 Chapter I.
6 Chapter IX.
7 Chapter CCXXVII.

1 Book II, Chapter 29.
2 Chapter X-11.

of cattle in work, and looking after their sanitation, etc. In the *Krishi Sangraha*,[1] a treatise dealing with agriculture, we find :

'A cattle-shed should be 55 cubits square and should not be constructed when the sun enters the zodiacal sign Leo, i.e. in the month of *Bhadra*.[2]

One who makes his cattle-shed strong, and keeps it clean from dung secures a healthy growth of his animals.

Goats should never be kept in the same shed with the cows. Rice-washing and fish-washing should never be done near the cow-shed; cotton, husks, hot starch, broomsticks, pestle, and stale food, should never be kept in the cow-shed.

To prevent outbreaks of cattle disease, the cow-shed should be frequently fumigated with the powder of *deodar* (*Pinus deodara*), *vacha* (Orris root) *mamsi* (*Pulvis veleriam*) · *guggulu* (a fragrant gum resin) asafœtida and mustard seeds mixed together. A *piniyaka* (asafœtida) tree should be planted near the cattle-shed in order to improve its general sanitation.'

Rules for plough cattle

For the employment of plough cattle, the following injunctions were observed :

'Hungry, thirsty, tired, deformed or diseased cattle should never be yoked to the plough.

When the plough oxen are eight strong for a plough, they may be worked for the whole day; when four strong, they should not be worked for more than half a day, and if the strength is only two, they should be worked for a quarter of a day.'

This view is also supported by other great authors like Atri, Parasara, Apasthamba, Gautama and Manu who say: 'He who uses eight oxen to a plough is a pious man, he who yokes six is a business man; while one who yokes four to a plough is cruel and one who uses only two is but a butcher.' It is thus seen that the importance of animal welfare had its own reaction on the socio-economic as well as the socio-religious life of the early Hindus.

[1] Verses 84 to 89.

[2] Leo is the fifth sign of the zodiac; the period when the sun is in the zodiacal sign Leo is roughly between the 15th August and the 15th September.

Treatment of animals in disease

As a natural result of such a reaction, many comprehensive treatises on the diseases of animals and their treatment came to be written by several authors. Apart from the many books dealing exhaustively and exclusively with veterinary science, it is found that most works in Sanskrit literature on religion, philosophy, metaphysics and politics, also abound in allusions to veterinary science. There is neither the time nor the space to deal with them in this article. A short extract from a translation from *Garuda Purana* will show how a book dealing with religion and politics gives casually much valuable and interesting information on veterinary matters.

Dhanvantary[1] said: 'Now I shall expound the ayurveda which deals with the diseases of animals, and the means of keeping them in sound health. Horses that are crow-lipped, black-tongued and bear-faced, as well as those that are hot-palatted or fierce-toothed, or are possessed of a greater or less number of teeth than normal, or born with only one testicle, or afflicted with scrotal tumours, or possessed of deformed backs, flat and spreading hoofs, or footed like cats, or striped like tigers, or affected by cutaneous eruptions or abscesses, as well as those which are extremely diminutive in size, or eyed like cats or monkeys, should be regarded as inauspicious and unfit for use. The best or first-class horses measure upwards of 4½ cubits in length, the second or middling ones measure half a cubit less than the first, and the last class 3½ cubits in length. Horses that are long-limbed, short-eared, mouse-coloured, and long lived are the best.

Ulcers which horses are afflicted with may be of two kinds: (1) *Agantaka* (traumatic or external origin) and (2) *Shariraja* (idiopathic or internal origin). Ulcers marked by a late suppuration should be regarded as due to the affliction of wind in the body; suppuration speedily sets in ulcers due to the action of deranged phlegm; while those due to deranged bile are marked by burning sensation.

[1] Chapter CCXXVI.

A plaster composed of *dhanti*[1] roots, the two kinds of *haridra* (turmeric), *chitrakam*, *vishabheshajam*, *rasonam* (garlic) and rock salt, pasted together with whey or *kanjikam* (a kind of fermented rice or barley gruel), or pastes of sesamum, fried barley grains, etc. mixed with powdered rock salt and curd, or paste of *neem*[2] leaves applied to ulcers in horses bring about their purification and healing. A medicinal oil cooked in combination with *karavira* (*Nerium odorum*), *kadali* (plantain), *arka* (*Calatropis gigantica*), *snuhi*[3], *kutaja*[4], *chitraka*[5] and *bhallataka*[6] brings about the healing of sinuses in horses. As an alternative, such a sinus should be washed with a medicinal ghee cooked in combination with a paste of the five astringent barks.

A compound consisting of the two kinds of *haridra* (turmeric), *vidanga* (*Embeliearibes*), the five kinds of salts, *patolum* (*Triconsanthas diocca*) and *neem* leaves, *vacha* (*Acorus calamus*), *chitrakam* (*Plumbago zeylamica*) *pippali* (long pepper) and administered through the medium of water brings about the expulsion of the worms from the intestines of horses.

A decoction of *neem* leaves, *patolum* (*Tricosanthus diocca*), *triphala*[7] and *khadira* (*Mimosa catechu*) should be successively given for three days to a horse, after bleeding it, for the cure of any cutaneous affections. Application of mustard oil proves beneficial in all cutaneous affections of horses attended with ulcers.

[1] *Danti—Baliospermum montanum.*
[2] *Neem—Melia azardirachta indica.*
[3] *Snuhi—Euphorbia nereifolia.*
[4] *Kutaja—Hollarrhena antidysenterica.*
[5] *Chitraka—Plumbago zeylanica.*
[6] *Bhallataka—Semicarpus anacardium.*
[7] *Triphala*—The three myrobolans, viz. embalia, chebulic and beleric myrobolans.

The medicine known as *haritaki kalpa* may be given to horses as a general prophylactic with much advantage. This medicine consists in giving five *haritakis* pasted together with rock salt and cow's urine daily to a horse. The dose of this medicine should be increased by five *haritakis* daily, until it goes up to 100 *haritakis*. The full dose of this medicine is 100, the middling dose is 80 and the smallest dose is 60 *haritakis*.

An oil prepared from decoction of *shringibera* (ginger), *bala* (*Sida cordifolia*), *mamsi* (Valerian) and *makshika* (beeswax) together with *saindhava* salt should be administered in diseases affecting the horns of cattle. An oil prepared with the essence of *manjishta* (*maddar*), asafœtida and *saindhava* salt will prove an infallible remedy in cases of otaligia. In sore-throat and rheumatic complaints the essence of the two kinds of turmeric and the drugs known as *triphala* (three myrabolans) should be given. The two kinds of *haridra* (turmeric) are deemed beneficial to a cow suffering from acute dysentery. In all digestive and pulmonary affections the expressed juice of *sringibera*[1] and *bhargi* (*Cleridendrum siphonathus*) should be given. Broken bones can be set right by a plaster of salt and expressed juice of *priangu* (*Panicum italicum*). An oil prepared and boiled with the drug known as *madhujasti* (root of *Abrus precatorius*) is an effective remedy in all bilious affections of the cow. An attack of cold will prove amenable to a concentrated decoction of *vyosha* (black pepper, long pepper and dry ginger) administered through the medium of honey.'

(*To be continued*)

[1] *Sringibera—Zingiberis officinalis* (green)

What the Scientists are doing

FIRED SOIL AS FERTILIZER

IT is a matter of common experience that in the absence of proper soil management heavy soils such as black cotton soil very easily lose their tilth on wetting. They become compact and sticky after continuous rain or on irrigation and later dry to hard clods. Under such conditions, seed germination is rendered difficult and often uncertain, growth becomes stunted and yield reduced. Various diseases also appear, causing much loss.

Yield increase 25 to 100 per cent

At the Institute of Plant Industry, Indore, investigations are in progress to control this loss of tilth under field conditions, writes Dr A. Sreenivasan, Agricultural Chemist. Encouraging results have already been obtained by the use of lightly fired soil. Soil so prepared ceases to become sticky when moistened with water. When tested for its influence on rain-grown and irrigated crops, improvement in the vigour of growth and fruiting was observed in every case. In particular, the effect of a surface application of lightly fired soil was markedly beneficial to cotton.

Fired soil was subsequently used, as a result of a private communication, in the Sudan-Gezira Research Station and yield increases of 25 per cent in seed cotton were observed. Further field trials on a large scale carried out at Indore also gave promising results, yield increases of 25 to 100 per cent in seed cotton being obtained.

Preparation of lightly fired soil

The following simple technique for firing black soil was found to give very satisfactory results:

Making the heap.—Stiff and thin stalks of crops such as those of *tur* (*Cajanus indicus*), sunn-hemp or cotton, reeds and jungle plants such as *ber* (*Zizyphus jujuba*) are arranged to form a circular layer 8 to 10 ft. in diameter and about 5 in. thick, the butt ends of the stalks being kept outwards in the form of a cart wheel. A bundle of fuel about a foot in diameter is placed vertically in the centre and around it but 3 to 4 in. away from it is placed a layer of soil about 3 in. thick in the form of a ring, leaving at least 6 in. of fuel uncovered all round the heap.

On the top of this ring of soil is put another layer of fuel in the same manner as the first layer. Upon this is laid another ring of soil around the upright central bundle of fuel which is kept projecting above the heap with fresh additions of fuel if necessary and which acts as a chimney. A third layer of fuel followed by a third ring of soil with a fourth cover of fuel completes the heap. Each successive ring and layer becomes a little narrower in diameter so that the heap tapers upwards into a cone.

Firing the heap.—The heap is lighted at the base, starting at the side away from the wind and thence on both sides towards the wind. The first fierce flames die down in about 15 minutes after which the burning is slow and smouldering. This is allowed to continue for some 24 hours, when the heap is broken.

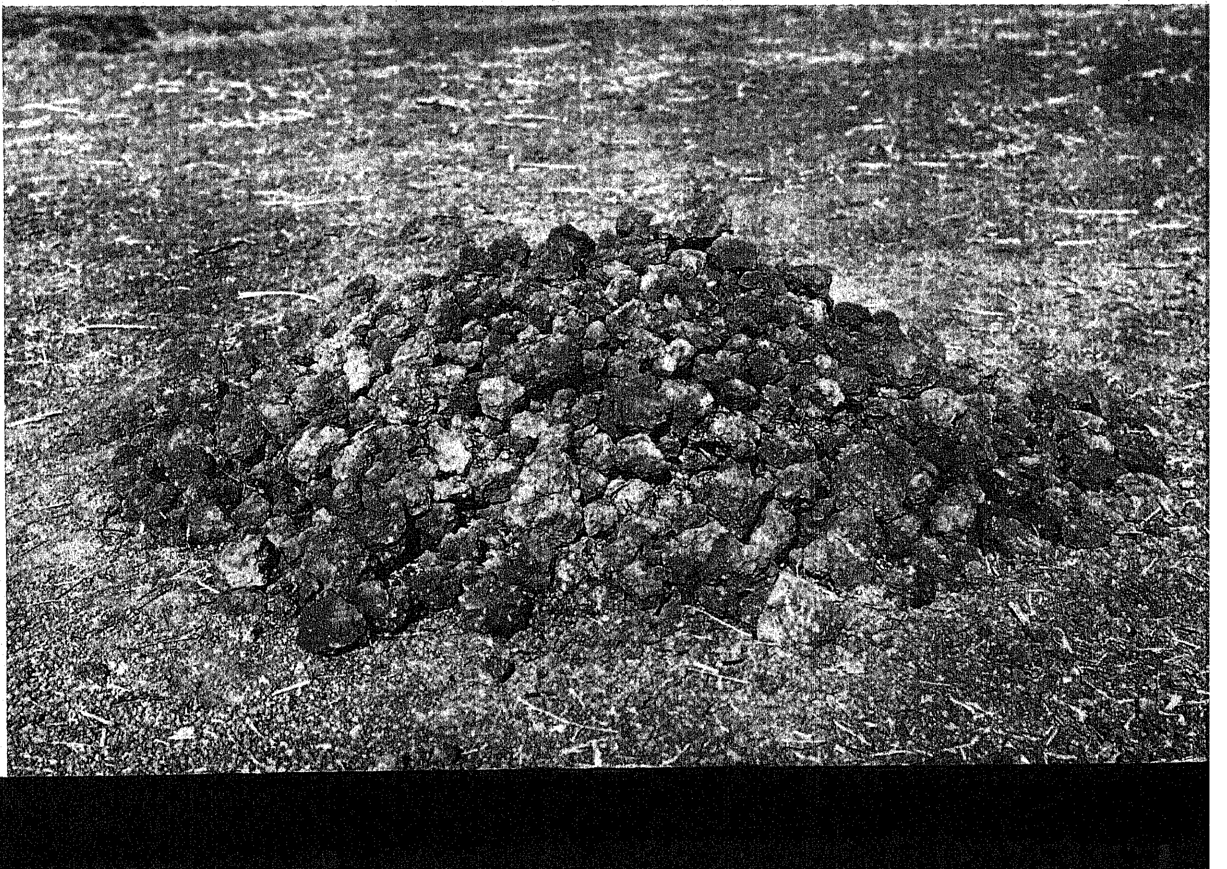
Quantities.—About 200 lb. of fuel is required to heat soil weighing about a ton. Examination of a number of heaps burnt in this way has shown that a properly burnt heap contains 15 per cent of soil over-burnt (brick coloured), 23 per cent of soil under-burnt (unchanged in colour) and 62 per cent of properly burnt (light or dark bluish purple in colour) soil.

Test.—The heated soil breaks into a granular powder and, unlike the original black soil, when put in water, does not become sticky but gives a suspension with purplish red flakes which do not make the water permanently turbid. Another reliable test to judge a properly fired soil is to add a drop or two of water to a lump, when it will be seen to crumble into a finely powdered condition.

Cost.—A heap of the dimensions mentioned above yields about half a ton of correctly

Fired soil is prepared by burning a heap made up of alternate layers of waste cotton or *tur* stalks or other suitable crop residues and soil. These photographs show such a heap before and after firing.

[PLATE]



Growth of cotton in plots treated with farm compost and fired soil respectively in comparison with an untreated plot

PLATE 142

fired soil and can be managed successfully by a man and two women three to four hours, the total cost of labour being about 7 annas. The collection of fuel and soil takes about an equal sum. Thus, the cost works out to Re. 1-12 per ton of fired soil. This quantity is sufficient for application to an area of two to five acres of land, a heavier rate being desirable for particularly poor lands.

Caution.—It is extremely important that the proportion of over-burnt soil, as indicated by its brick-red colour, should be kept down to low limits. Over-burnt soil, when mixed with raw black soil, packs and cakes even worse than black soil alone. Under such conditions, crops naturally suffer very badly.

Method of application

Fired soil can be applied either in small trenches or as a surface dressing preferably after mixing with its own weight of loose surface soil. It can also be applied in 6 in. deep bores 4 ft. apart made by an earth auger or in small hand-dug pits. An interesting observation has been that fired soil has a lateral effect extending to at least 2 ft. from the site of application. Fired soil application has also a high residual effect.

The possibility of light firing of the surface layers of field soils by burning waste organic matter *in situ* in the fields is in course of investigation.

Laboratory studies have shown that fire-heating results in a marked improvement in the physical texture and degree of aggregation of the soil colloids and is also followed by a slight decrease in exchange capacity and in replaceable calcium and magnesium, an increase in replaceable sodium and potassium and in total soluble salts and a loss in organic matter.

Old systems compared

Fired soil application may be compared to certain early practices in agriculture. Thus, hill tribes bring forest land or scrub into cultivation by a process of burning of the vegetation. Graziers set fire to grassland so as to obtain a sweeter and better feed for the cattle during the following year. Heating the soil has also been adopted sometimes as a measure in garden and green-house cultivation. The *rab* system of rice cultivation in which rice is grown in seedbeds prepared by burning waste organic matter on the ground as well as the old method of 'paring and burning' heavy land in temperate countries wherein clay is burnt in heaps at a low temperature and then spread on the land may also be considered similar processes. It is believed that, as a result of such practices, the soil is sweetened and cleaned, parasites and weeds killed, mechanical texture improved and the available plant food increased.

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FOWL SPIROCHAETOSIS IN INDIA

FURTHER work on fowl spirochaetosis and immunization of fowls against the disease is being carried out in systematic manner by the Veterinary Officer of the Imperial Veterinary Research Institute, Mukteswar. For this purpose a strain of *Spirochaeta anserina*, the microbe which causes the disease, is being maintained at the Institute by refrigerating infected blood and passing it periodically through fowls. Infected blood kept in the refrigerator for two weeks or more seems to be weakened during its first passage in fowls but the potency or virulence is soon regained in subsequent passages. The fact that the microbe is weakened by refrigeration has been made use of for immunizing birds against the disease without resorting to the use of drugs.

During the course of 8 months 17 batches of birds, totalling about 800, have been immunized by using infected blood, both in the virulent as well as in the weakened state, in conjunction with or without various arsenical preparations such as atoxyl, soamin and sulfarsenol. The last-named drug seems to have given more encouraging results than the other two.

The duration of immunity is also being worked out by exposing the immunized birds to natural or artificial infection, and according to tests so far completed the immunity has been found to be strong for about five months.

Much information is also being collected on the various factors that might be concerned with immunization such as age, bodily condi-

tion, breed of fowl, proper dosage of drugs, idiosyncrasy of different breeds to different drugs, complications that might occur. One important observation is that fat birds are not suitable subjects for immunization.

It is reported by some workers that a rise of temperature (fever) is not one of the symptoms of the disease but we have found that the disease always begins with a rise of temperature above 108°F. and may even reach 110°F. before the parasites appear in the circulating blood; the normal temperature of the fowl, as observed in about 500 healthy birds, ranges from 106·5° to 107·5°F.

In addition to the above observations a detailed study is also being made on the course of the disease, the various changes which occur in the blood, post-mortem appearances in affected birds, etc. A detailed report of the work so far done will be published shortly.

CONSTRUCTIVE PLANNING BY SCIENTISTS

SCIENTISTS from all parts of the world—22 nationalities in all—met on September 26 to 28 at the Royal Institution, London, to contribute to a three-day conference which aims at linking up science with Government for the betterment of human life.

Sir Richard Gregory, President of the British Association, had recently urged the necessity for those in control of public affairs to understand the power which science places in the hands of mankind for construction and human betterment.

The conference, which is under the auspices of the British Association, aims at better relations between science and Government, administration and other agencies concerned with constructive planning for the present and future.

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q: I intend starting goat and sheep farming at Aligarh. Kindly give me the following information:

Which breed of goat is the best in India for mutton and likely to flourish in the climate of Aligarh?

Which breed of sheep is the best for both wool and meat?

Where can I make my first purchases?

Does Government help such enterprise by providing free or at cost male animals of these breeds?

Are there any model farms in India for goat and sheep farming?

Can you give me references to standard works on goat and sheep farming and treatment of the diseases to which sheep and goats are subject?

A: Hissar Dale sheep and Jamna Pari goats will be most suitable for your purposes in the climate of Aligarh. The former are obtainable from the Superintendent, Government Cattle Farm, Hissar, and the latter from the Principal, Agricultural Institute, Allahabad. Further details regarding prices, etc. may be obtained direct from these officers.

A visit to both these farms would, no doubt, prove useful.

The Director of Veterinary Services, United Provinces, should be addressed regarding information concerning facilities or subsidies, if any, given for goat and sheep farming.

No standard book on sheep or goat farming has so far been published in India. Some of the provincial Veterinary Departments have, however, published bulletins dealing with breeding, feeding and management of sheep and goats as well as control of their common diseases. These may be obtained direct from the Directors of Veterinary Services in the United Provinces and in the Punjab.

Q: We propose extracting orange juice, sterilizing it and supplying it in tins. We understand orange juice is purchased by distillers for the manufacture of alcohol. Kindly give the method of sterilizing and tinning orange juice in kerosene tins.

A: Unsweetened orange juice is usually imported into India in small tin cans. These cans are filled by a special process of vacuum packing for which expensive equipment is required for de-aeration and flash pasteurization. This type of juice is meant for immediate consumption on opening the tins.

There is another way of packing orange juice in bulk. Such juice is used for making squashes and syrups. For this purpose juice is kept in wooden barrels and not in tins because its preservation requires the addition of sulphur dioxide, a chemical which reacts on tin (if juice is packed in tins) and produces undesirable substances which impart bad flavour to the juice. The permitted dose of sulphur dioxide for orange juice is 350 parts per million parts of the juice. It can be added in the form of potassium metabisulphite, a compound which contains about 50 per cent sulphur dioxide.

Orange juice should not be put in kerosene oil tins but in properly sterilized wooden barrels and preserved by sulphur dioxide. Juice packed in this manner has a market in this country. There are firms which prepare squashes on a large scale and such firms may perhaps be willing to purchase the juice.

Distillers use orange peels for flavouring and the juice is not actually used for this purpose. In foreign countries, orange juice from third class fruit which is otherwise unfit for consumption is used for making wine and

the juice used for this purpose is practically a waste from an orange squash manufacturing factory.

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Q: I am keeping a large number of cows and buffaloes for supplying milk. Some of these are quite high yielding animals. Please inform me how I can get them registered.

A: The Imperial Council of Agricultural Research has established central Herd Books for Hariana, Sahiwal and Sindhi breeds of cattle and Murrah breed of buffaloes. Animals belonging to any of these four breeds and conforming to the definition of breed characteristics as laid down in Miscellaneous Bulletin No. 27 of the Council can be considered for registration provided they come up to the prescribed standard of milk production. The milk yield qualifications are 2,000 lb. per lactation for Hariana, 2,500 lb. for Sindhi and 3,000 lb. for Sahiwal and Murrah breeds. The animals offered for registration must also be distinctly marked for identification by tattooing or branding.

A copy of the Rules and Regulations for the Central Herd Books and specimen forms can be obtained free from the Secretary, Imperial Council of Agricultural Research, New Delhi. If you agree to the conditions laid down in the Rules and if you have animals which, in your opinion, are qualified for entry in the Herd Books, you may inform the Council of the number of qualified animals you have in each breed and the necessary forms will be sent free of charge. On receipt of the applications for registration, arrangements will be made in due course for the inspection of the animals and of their records. Certificates of registration will be issued thereafter.

His Excellency the Governor of Bombay at the Kumpta Farm, inspecting pineapple cultivation—Kew and Queen varieties. The big one is Kew, 18 lb. in weight

What's doing in All-India

BOMBAY

By B. S. Patel
Principal, College of Agriculture, Poona

HIS Excellency the Governor of Bombay toured through the coastal tract of Ratnagiri and Kanara districts. On his way to Ratnagiri His Excellency inspected the Hat-Khamba Farm 12 miles from Ratnagiri. This farm has been developed to demonstrate how the sloping hilly areas covered with shrub and tree growth, called *varkas* lands, a typical feature of the belt, could with little expense and effort be brought under fruit trees like mangoes and *kaju* (kashew nut) trees within five years. The Rural Development Department are now active in extending their activities in this direction by distributing plants at cheap rates and by helping in the establishment of such plantations.

18 lb. pineapples

At the Kumpta Farm, the main items of agricultural improvement were examined by His Excellency with keen interest. The improved sugarcane Co 419 and HM 544 have so far replaced the local soft variety of Daskabhu to the extent of more than 60 per cent of the area with *gul* yields of more than 15 per cent. The striking item seen by His Excellency was the success of exotic pine apples—Kew and Queen varieties acclimatized and selected to replace the local one. In the case of the Kew the highest fruit weight was nearly 18 lb.—a record yield which is nearly five times the yield of the local pineapple. These new pineapples have the best quality and flavour and fetch a very handsome price and can be transported for marketing to any part of India. They are spreading very fast. Another notable feature was the successful establishment of the tung oil plant at present monopolized by China for export in connection with special oil for paints and aircraft. In grain crops valuable strains of paddy to replace the coarser, less palatable and uneconomic local varieties were seen and appreciated by His Excellency the Governor.

Anti-erosion works

In place of the usual scarcity works, this time the Government have concentrated on land development against soil erosion and conservation of moisture in the precarious rainfall tract of Bijapur where crops generally fail. All *bunding* staff in the Karnatak have been located there and over 600 acres of *bunding* every month has been finished since April last. The cultivators are given subsidies as well as *taccavi* loans for taking up such works. There is a rush of applications from the cultivators. In view of the need for land development and conservation of moisture by contour *bunding*, the Government have sanctioned a very big scheme with a complement of three additional technical officers, with staff, equipment, etc. for coping with the greatly increased demand from the cultivators.

Jowar *for Ahmedabad*

In North Gujarat, cultivators grow *jowar* mainly for fodder. The variety grown on sandy soil is *utavali*, the fodder of which is inferior in quality. A selection called 10-2 has been evolved by the Cotton Breeder, Viramgam, the fodder of which is superior in quality and fetches a better price in the market. Its straw is thin and its leaves have green midrib. Its chief quality is earliness, thus giving out heads when other selections do not and are thus dangerous for feeding, particularly in dry seasons. The fodder is, therefore, much sweeter than that of *utavali*. Feeding trials of 10-2 indicate that very little

is left in the byre, whereas 30 per cent is wasted in the case of *utavali*.

Special care should be taken in sowing 10-2 at closer distance between rows (as the plants are not as tall as *utavali*) and may be thinned at a distance four to six inches between plants by working with *panjete* (fork used in threshing yard), a cheap method of thinning.

The average yield of fodder of 10-2 during the past 4 years has been 3,168 lb. per acre against 2,883 lb. of *utavali*. The grain yields are almost equal (350 lb.). The estimated average income per acre from 10-2 is Rs. 31 against Rs. 23 of *utavali*. Field trials in the district will be undertaken during the coming season.

Cattle fair at Kunnur

In January a big cattle fair and show was held under the auspices of the Taluka Development Board, Chikodi, where 5,000 head of cattle were collected.

These consisted chiefly of Khillar and Krishna valley breeds. To make the show more interesting and to educate the cultivators of this part of the taluka, a small agricultural show was also held.

To encourage the people to breed better types of cattle and to grow better crops, prizes were awarded to the best animals and produce exhibited. Prizes amounted to Rs. 175 with two Government medals spared by the Livestock Expert to the Government. In all 19 prizes went to Khillar and 29 for Krishna valley cattle. A larger number of prizes were set apart to encourage the Khillar breed as it has been found that animals of this breed are fast disappearing.

The Government medal was won by the breeding bull of the Better Farming Society of Bhoj and a cow of this village won the other medal for the best cow.

The prices at the fair were:

KRISHNA VALLEY BREED

Best bull above four years ranged from Rs. 150 to 225.

Best bull above two years and below three years, Rs. 100 to 150.

Price of working bullocks, Rs. 250 to 400 per pair.

KHILLAR BREED

Best bulls above four years of age ranged from Rs. 150 to 250.

Best bulls above two years and below three years of age ranged from Rs. 75 to 175.

Pairs of working bullocks ranged from Rs. 150 to 350.

Jarila seed stockists

Owing to the high premium obtained for jarila cotton in Khandesh, the demand for the seed of this variety was very keen. For the first time in Khandesh and Nasik districts, an organization of approved stockists was set up to purchase seed produced under stage V. The number of such stockists was 144, classified as under:

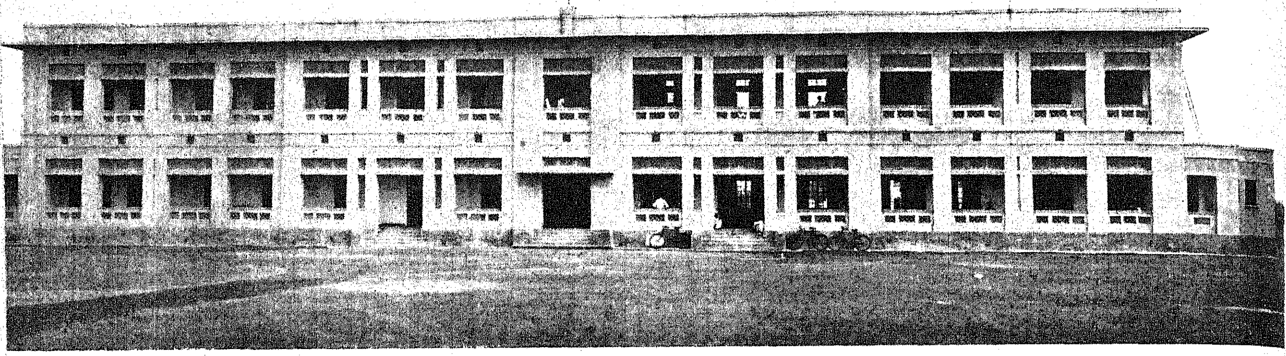
Cooperative purchase & sale unions	5
Cooperative societies & taluka development associations . .	16
Landlords & seed suppliers . .	80
Merchants & commission agents .	43
TOTAL .	144

The stockists were given a subsidy of 8 as. per bag of 140 lb. seed of jarila for stocking and distributing the seed in the manner approved by the Agricultural Department, the number of jarila cotton seed bags stocked being 23,323.

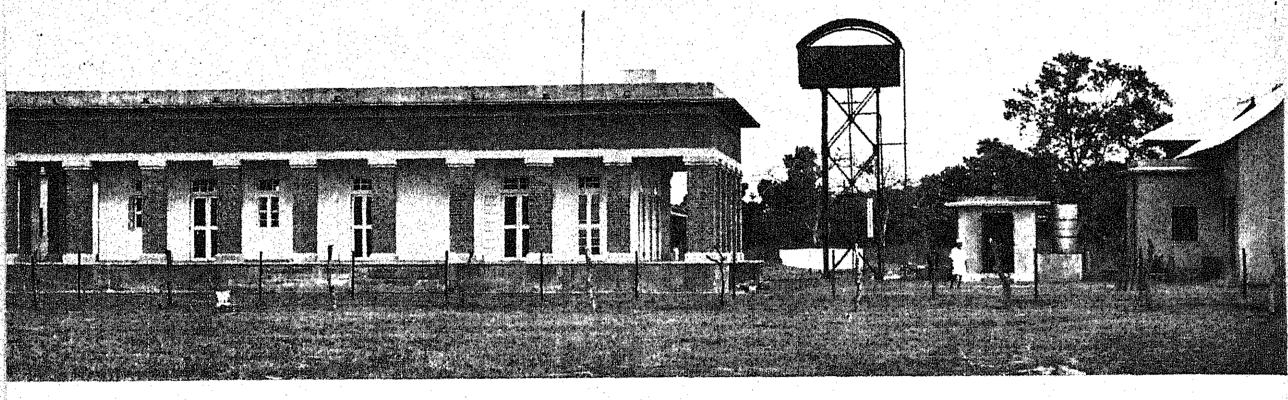
Proposals for the extension of jarila cotton seed multiplication and distribution as well as for the Jalgaon cotton breeding scheme, Khandesh, for a further period of five years (1942-47), were submitted to the Indian Central Cotton Committee in June 1941.

Rural training centres

With a view to training students in agriculture, cooperation, cottage industries, village sanitation, forestry, marketing, veterinary science and methods of propaganda, sufficient to equip them as rural assistants engaged in village improvement work, two training centres, one at Manjri (Poona district) and another at Dhulia (West Khandesh), were opened from May 1941. The number of students admitted was 28 and 33 respectively, each student being given a stipend of Rs. 20 per month during the period of training, which consisted of nine months at the centre and three months of specialized training at Poona,

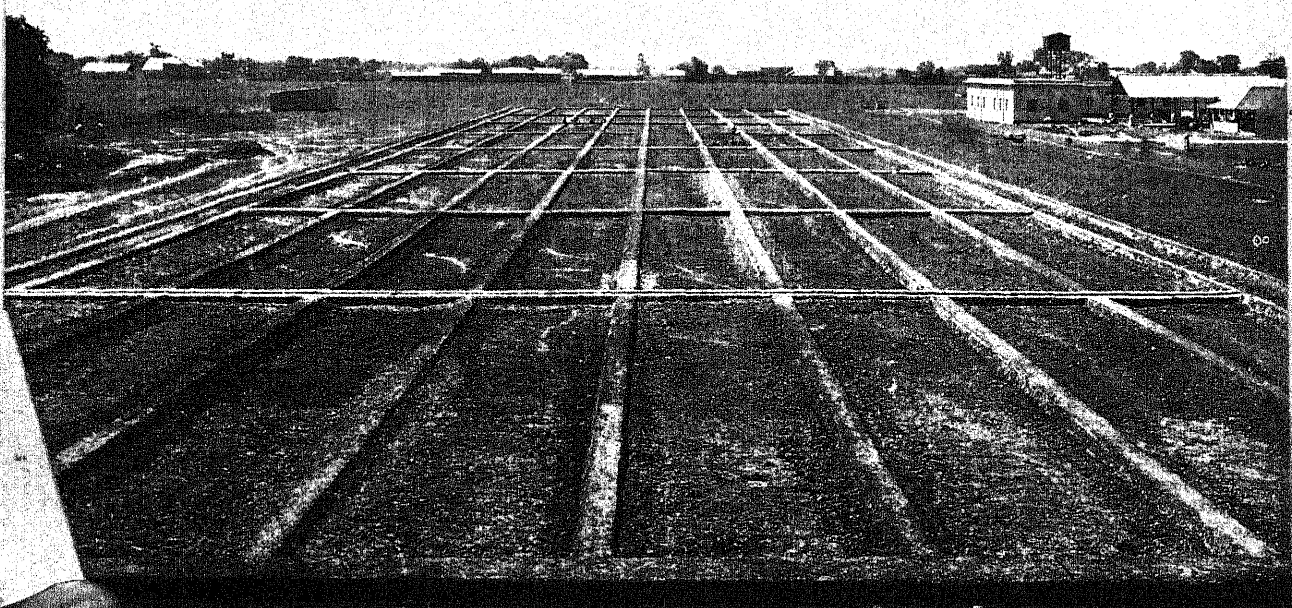


The Bengal Agricultural Institute, Dacca



The Dairy, an important centre for the animal husbandry section

Experimental plots for upland crops in front of the hostel



On account of its abnormally low price groundnut cake is being freely used as manure for sugarcane and cotton crops in the Deccan.

OPENING OF THE BENGAL AGRICULTURAL INSTITUTE

By W. M. Clark, M.B.E., B.Sc., I.A.S.
Principal, Bengal Agricultural Institute, Dacca

THE formal opening of this Institute on 27 July 1941 by His Excellency Sir John Herbert, Governor of the Province, at the invitation of the Hon'ble Mr Tamizuddin Khan, Minister for Agriculture and Industries, Bengal, stops at long last (34 years after the opening, for example, of the Poona Agricultural College) a standing question addressed to officers of the Bengal Agricultural Department. Bengal has now got a teaching institution at which men can be given a degree course fitting them for posts in the Department and, for that matter, outside it as well. Schools for training demonstrators have been successfully in operation since 1922 and now that a teaching staff has been got together at the Institute we shall no doubt soon see the usual addition of short courses for particular ends.

First in the field

Bengal has never been indifferent to agricultural education and indeed one of the first courses provided in India on the subject was that which opened in 1898 at the Sibpore Engineering College; but, in view of the many other needs it was never a matter for which money was made available until now.

The Agricultural Section at Sibpore was closed in 1904, the opening of the Pusa Institute being considered a sufficient reason for doing so.

The photograph of the Institute which accompanies this article shows a building which will appear small to those accustomed to the large combined research and teaching institutions of other provinces. In Bengal the Research Section grew up on its own and the two laboratory buildings in which the work of the Department since 1911, and (since 1939) that of the Indian Central Jute Committee, has been done are situated 1½ miles away although within the boundaries of the 650 acres comprised in the old Dacca Farm and the new and contiguous Institute one. Both farms are within one perimeter fence so that the research material of the old Farm is readily made available for the instruction of the students on the new one.

Equipment

Situated within 400 yards from the Institute are the various well equipped units which contribute towards the instruction given to the students—the Engineering Section with its six students' blacksmiths' forges, moulding shop, carpenters' and fitters' benches; the Livestock Section with its 65 cows and buffaloes and 190 head of stock in all, its Dairy and its Poultry and Goat divisions, and the Agronomy Section with its bullocks, tractor, implements and facilities for work in the field and at the steading. In the Institute itself in addition to the museum, library, drawing-office and lecture rooms, is situated the Botanical Section organized to give students detailed knowledge of crop plants including horticultural ones, to select and breed, and to recognize and then fight insect and fungus pests. Separate laboratories for dairy chemistry and bacteriology have still to be built.

The B.Ag. course, given in association with Dacca University, is only a two-year one and half of each day is spent using hand and eye in the various sections, but the entrance qualification demanded is a B.Sc. which has included Botany. Fourteen of the twenty students to be admitted (the first class having begun work on 16 April 1941) must have graduated at Dacca in a B.Sc. course specially designed

to fit in with the later B.Ag. one. The plan is a novel one and the dangers are obvious. All that can be said at present is that the troubles feared have not, so far, arisen.

Practical work

It has still to be found out, however, whether the amount of practical work which can be given, even when given daily over 20 working months, is sufficient to create the background required by the students in their future careers. Recognizing this possibility, it has been laid down that students must pass a milking test within two months of entering on their course and in order to give sufficient training four mornings each week are spent during this period in the dairy. It has proved possible by such training to get over quickly the initial period of uncertainty common among lads who have not previously handled animals. The results were seen on the opening day when students who three months before had never previously handled a bullock were shown to His Excellency and the members of the Bengal Government present ploughing and harrowing with every appearance of self-confidence. It has further to be noted, in estimating the probabilities, that the crop year is much longer in Bengal than in those provinces in which most of the older teaching institutions are situated so that more practical work can be done during a shorter period of total time. The first year class works from April to December, goes on holiday from Christmas and enters on its second year from the 1st February. Work will again go on until Christmas and the degree examinations will be held in the following February. Between these dates the only holidays enjoyed will be those declared for Government offices. The results of such a scheme of training will no doubt be awaited with interest in provinces other than Bengal.

ASSAM

By S. Chakrabarti, B.A. (Hons.)
Assistant, Office of the Director of Agriculture, Assam

A MEETING of the agricultural section of the Advisory Board for Development, Assam, was held at Shillong in June, presided over by the Hon'ble Maulavi Munawwar Ali, Minister for Agriculture. The Advisory Board for Development was constituted in 1926 'to advise Government on the policy and work of the Departments of Agriculture, Industries and Cooperative Societies'. The constitution of the Board has since been modified and it now consists of three sections, one for each of the Departments mentioned above—the agricultural section of the Board consisting of three officials of the Department of Agriculture, four members of the Assam Legislative Assembly, one member of the Assam Legislative Council, one private individual and the Hon'ble Minister for Agriculture, who is the President of the agricultural section. The June meeting was attended by Mr L. Barthakur, Director of Agriculture; Mr R. C. Woodford, Deputy Director of Agriculture, Livestock; Dr H. K. Nandi, Economic Botanist; Rai Sahib P. N. Chaudhuri; Mr S. M. Lahiri, M.L.C.; Mr B. B. Das, M.L.A.; Mr N. K. Datta, M.L.A.; Mr A. Salam, M.L.A.; and Mr R. C. Kachari, M.L.A.; Mr A. H. Chaudhuri, Deputy Secretary to the Government of Assam; Rai Sahib S. C. Ghose, Director of the Veterinary Department, Assam, and a few other officers of the Agriculture and Veterinary Departments attended the meeting on invitation. The meeting considered a large number of suggestions for the improvement of agriculture and animal husbandry, such as introduction of soybean and tung cultivation, preservation and canning of fruits, cultivation of maize on a commercial scale, buffalo breeding, organization of cattle *melas* (fairs) and

establishment of agricultural schools. All the recommendations of the Board are now being considered by the authorities concerned.

Bone-meal as manure

As the supply of cattle manure is limited in the hill tracts of Assam and as it is also difficult to carry bulky manures to the small holdings perched high up on the hills, the Department of Agriculture has been conducting demonstrations on the use of bone-meal as manure for wet paddy land in the hope of improving paddy cultivation in the hill areas. In the Khasi and Jaintia hills these demonstrations have consistently produced a marked effect on the appearance and yield of paddy, and it has been found that an application of three maunds of bone-meal increases the average yield by about 50 per cent of grain, in addition to heavier yield of straw—the increases due to the application of bone-meal being valued at twice the cost of the manure. It has also been observed that the residual effect of the manure continues up to the third year after its application. The success of the demonstrations carried out so far in different localities of this district has convinced the cultivators of the advantages of applying bone-meal as manure for wet land paddy cultivation and during recent years there has been a great demand for this manure in the Khasi and Jaintia hills—so much so that dealers have found it profitable to engage in its supply.

Bone-meal used to be sold by the Department of Agriculture, but now, due to the steadily increasing demand for the manure, local businessmen have taken up the work, and now supply the requirements of the Khasi cultivators. Roughly speaking, about 12,000 md. of bone-meal are annually sold in the Khasi and Jaintia hills. About 2,000 md. of raw bones are collected and crushed locally by a rough and ready method, that is by pounding bones with iron pestles in stone mortars. There is also one bone crusher at Mylliem, near Shillong, where bones are crushed with water power, which turns out a big quantity of bone-meal. The Department of Agriculture has thus not only improved the outturn of paddy, but at the same time brought into existence a whole chain of producers and dealers in bone-meal to the great advantage of the people of the Khasi and Jaintia hills. It is hoped similar developments will take place in other hill tracts of the province as the people of those areas find it necessary to adopt more extensive permanent cultivation.

Sugarcane

As a rain-fed crop, sugarcane cultivation in Assam has immense possibilities on account of many local advantages, such as high humidity, copious rainfall between March and May before the onset of the monsoon, large extent of suitable waste land available for cultivation and the absence of dry hot weather. Experiments at the Sugarcane Research Station at Jorhat (partly financed by the Imperial Council of Agricultural Research) have clearly shown that superior varieties of sugarcane can be grown very successfully in Assam. The Department has up to date issued 20 improved strains of sugarcane, the average yield from which is estimated at 770 md. of stripped cane per acre, one variety—Co 419—yielding as much as 1,251 md. of stripped cane per acre. Demonstrations with these varieties, together with demonstrations on rotation, improved cultural operations and use of manures are also being conducted. As a result of these operations, 35·8 per cent of the total acreage under sugarcane has been brought under improved strains. Progress so far made has been somewhat slow in the direction of extension of cultivation and manufacture of sugarcane. Steps are, however, being taken for increasing sugarcane cultivation and for the manufacture of sugar according to the Khandsari system.

Potatoes

The Department of Agriculture has been carrying on trials with different kinds of potatoes imported from England and have been able to acclimatize a large number of varieties—43 to be exact—known as Shillong potatoes. These varieties have given 80 to 150 md. per acre in Government agricultural farms, while 70 to 120 md. have been obtained

under cultivators' conditions. These potatoes, which are of large white type, have now spread all over the Khasi and Jaintia hills—the district in which the Upper Shillong Farm, where experiments with imported potatoes are conducted is situated. From here over 2½ lakhs of maunds of potatoes are exported every year. The Khasi cultivators have become skilled in growing potatoes, unknown in these hills before the Department introduced them and have overcome the difficulty of storing seed by cleverly growing a winter crop specially to produce seed for the main summer crop. Steps are now being taken for introducing Shillong potatoes in the other hill areas of the province. Shillong potatoes can also be grown in the plains in the *rabi* season under irrigation; but due to the difficulty of storing seed, Shillong potatoes have not been able to make much headway in the plains. The Department is, however, making trials with Darjeeling potatoes which appear to stand the rigours of the plains climate better. Trials with Burma and Italian potatoes, which are grown all over the Bombay Province, are also being made to find out whether they will suit plains conditions in Assam.

Jute handicaps

Although jute is becoming a very important money crop in Assam, its further development is being held up in the absence of knowledge regarding the suitability of the different improved strains to Assam conditions. It is not known which improved varieties will thrive best in this province. Development is also being retarded owing to the inability of the Agricultural Department to distribute sufficient quantities of seeds of those improved strains which are now being grown in Assam. The methods of steeping, retting and washing obtaining in Assam also leave much room for improvement. It is also not known how far jute grown in rotation with other crops helps to increase the outturn of these crops. With a view to removing these difficulties, a scheme of research on jute was recently submitted by the Government to the Indian Central Jute Committee for carrying on varietal, cultural and seed multiplication research as well as trials on steeping, retting, washing, etc.

The scheme, which will be financed jointly by the Government of Assam and the Indian Central Jute Committee, has recently been sanctioned. Experiments will be carried out in collaboration with the Director of the Jute Research Laboratory, Dacca. The research station will be established either at Barpeta or at Mangaldai and work is expected to be started before the next jute sowing season.

SIND

By L. M. Hira
Senior Marketing Officer, Sind

UNDER Agriculture, the Government have recently, through the supplementary statement of expenditure placed before the Sind Legislative Assembly, made a provision of Rs. 1,64,500 for the purchase of cotton seed of improved varieties. Assisted by the Indian Central Cotton Committee, the department of Agriculture has now on hand a well worked out plan for the improvement of cotton, and the supply of pure seed is the first step in that direction.

Milk recording

Another useful scheme is for milk recording of the best Sindhi breed of cattle, the Red Sindhi cows. The scheme has been sanctioned by the Imperial Council of Agricultural Research and the cost is being borne by the two parties. In this connection it will be interesting to note that Sind takes the pride of place in India so far as consumption of milk and milk products is concerned, with 22 oz. per head per day, followed by the Punjab with

19·7 oz. According to the *Report on the Marketing of Milk in India and Burma* recently issued by the Agricultural Marketing Adviser to the Government of India, the average daily consumption of milk in India is 6·6 oz. per head of population per day, including milk products, and this varies from tract to tract according to the production of milk and the density of population.

In other countries the average daily consumption is more than five times the average figure for India, the reason being that in those countries, consumption has considerably improved through state aid and better planning of the dairy industry during the last 25 years.

In India, the rate of increase in the number of cattle has not kept pace with that of the human population and consequently consumption may be said to be on the decrease. Matters could, however, be improved without much difficulty. Production could be increased by about 50 per cent by proper feeding and management of existing cattle and consumption could be stimulated by organizing 'Drink more milk' campaigns on a national scale.

Woollen industry

Raw wool is a commodity which notwithstanding its close association with war supplies in the nature of blankets and warm clothing for troops, has still not found its use expanded in India itself except for the production of articles of rough wear.

The economic possibilities of an organized wool industry are great in this province, even not taking into account the scope for the expansion of exports of finer quality of raw wool to outside countries.

Wool, being connected with animal husbandry, can be improved in quality not only by better methods of shearing and grading but also by securing better breeds. The work needs intensive propaganda, which can be usefully taken up and enlarged by the Marketing section in cooperation with the Department of Agriculture.

The great stimulus that is now being given under stress of war to various industries ought also to be directed to organizing the wool industry, particularly on a cottage basis. That the demand for woollen goods is great is seen by the fact that even a small *ashram* at Gadro engaged in the manufacture of woollen goods has found an opportunity to send out its quota of necessary comforts for troops.

It is gratifying to note that a beginning has been made in this direction and a small sum of Rs. 1,000 has been provided by the Government as a subsidy to the All-India Spinners' Association for producing woollens.

COCHIN

By M. Sankara Menon, B.A., B.Ag.
Economic Botanist, Cochin State, Trichur

ON 26 May, Cochin, like the rest of the West Coast, suffered one of her worst calamities. A cyclone of unprecedented fury swept over the whole state, spreading devastation everywhere. The storm started at dusk and raged with increasing fury until the climax was reached between 10 and 11 p.m., when trees big and small began to fall and buildings to tumble down. The storm raged for about 12 hours. A rainfall of 12·5 in. for the day was registered, which is a record for the state.

Thousands homeless

The damage caused by the cyclone is indescribable. From official reports, it is seen that about 40,000 houses collapsed and thousands of people were rendered homeless. The fall of trees everywhere, over public roads, buildings and compounds, rendered movement

difficult. To add to the misery, floods rose as a result of continuous downpours, and all traffic was brought to a standstill for the next few days.

The cultivators had a bad time. Paddy, the main crop, did not suffer except for a temporary setback brought about by the sudden floods and the consequent washing off of the *bunds* and silting up of certain areas. But the garden crops had to pay a heavy penalty.

The banana is an important crop, occupying an area of about 2,500 acres. The crop was in its very prime, just putting forth its heavy pendulous bunches. It is mainly a crop of the poorer ryots who had invested their all and borrowed heavily upon it. Almost the entire crop was wiped out.

The arecanut is another important money-crop. It occupies an area of 24,000 acres. Enquiries in typical areas show that 20 to 25 per cent of the trees have been blown down. This too has spelt the ruin of several poor ryots.

The coconut is much hardier, and although the number of trees that fell was comparatively less, the crop suffered badly by the tearing and twisting of the leaves and the shedding of large numbers of nuts both mature and immature. The prospect of a proper harvest during the coming year is gloomy.

Plight of rubber

Fruit trees suffered badly. The important fruit trees are the mango and the jack, and a large number of these gigantic trees yielding heavy crops and sustaining the population during the summer months have been uprooted. It will be long before they are replaced. The cashewnut gardens also suffered severely with thousands of trees uprooted and equally large numbers damaged by the tearing away of branches. Hundreds of tamarind trees, which too are of economic importance, have fallen.

Of the plantation crops, the one that suffered most was rubber. There were 12,000 acres of rubber. The plantations, which had been hit hard by the economic depression, were gradually reviving under the Rubber Restriction Scheme when all on a sudden all hopes were dashed to the ground. The trees fell by the thousand and the plantations presented a woeful appearance. It is estimated that between 75 and 80 per cent of the trees have fallen and several plantations have to start their plantings anew.

Small loss of life

These are only the outstanding instances, and it is difficult to describe all the havoc wrought by the cyclone. In this cataclysm the one redeeming feature was that the loss of human life and cattle was extremely small. Although it was the dead of night when buildings tumbled down and trees toppled over, there were several providential escapes. But the loss to property was untold.

The Government realized the seriousness of the situation and immediate measures of relief were ordered. A sum of Rs. 2,70,000 was granted for immediate relief. Small sums up to Rs. 10 were given to the homeless poor. Rice was distributed to the starving population in the flood-stricken areas. Larger sums amounting to Rs. 50 and Rs. 100 were issued as loans on very easy terms of repayment. The commutation rate of paddy on dues to the Sirkar Devaswams was reduced and all coercive measures in cases of civil suits were temporarily suspended. A number of public works to give employment to the poor were also started. These, no doubt, have gone a long way to relieve the immediate distress; but it will be long before the economic prosperity of the agricultural population will be restored.

The Month's Clip

SOYBEANS : A PROTEIN FEED

IN the production of livestock the farmer aims to grow as much of the required feed as possible on his farm. The three main constituents of feeds are carbohydrates, protein and fat. Carbohydrates are usually found in sufficient quantities in most plants and seeds. Protein, however, may be lacking in the amounts required to provide a balanced ration. In order to correct this deficiency, such high protein feeds as cottonseed or linseed oil meals must be purchased. Where this extra amount of protein can be produced on the farm, a definite saving in cash outlay is obvious. As a high protein crop the soybean is useful for this purpose.

The protein content of soybeans may be taken advantage of in two ways, states C. W. Owen, Dominion Experimental Station, Harrow, Ontario. The crop may be cut in the stage when the pods are about half filled and cured as hay, or the seed may be allowed to ripen and harvested as grain. Soybean hay will be found about equal to alfalfa in feed value, but in districts where alfalfa can be sucessfully grown its main use would be as an emergency hay crop. In other districts possibilities exist for soybean hay where annual crops avoid loss through winter killing.

Soybeans fed as grain contain about 35 per cent protein and 16 per cent oil. The whole beans may be added to the grain ration before grinding and will be found palatable by all classes of livestock. In the case of bacon hogs, soybean oil meal should be used in preference to whole beans in order to eliminate the danger of soft pork.

Whole soybeans added to the grain ration of dairy cattle have been found to give excellent results by a number of farmers. From the dairy standpoint it is fortunate that a large portion of the area engaged in milk production is suitable for growing soybeans, and more farmers are realizing the advantage of growing a small acreage of this crop each year for use as a protein supplement.

Apart from the feeding value of soybeans some soil benefits are also obtained. Being a legume, soybeans have the capacity of utilizing nitrogen from the air providing the seed has been inoculated with a culture of nitrogen-fixing bacteria before planting. In this way a part of the nitrogen utilized by the crop is returned to the soil. On heavier types of soil some improvement in tilth may be noted following a crop of soybeans.

Considering the wide adaptation of the soybean to both soil and climate, together with the variety of uses to which the crop may be put, possibilities are enormous in this high protein content crop.—*Press Note, Dominion Department of Agriculture, Canada.*

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VITAMIN NEEDS OF SWINE

WHEN fast-growing pigs suddenly become affected with a form of posterior paralysis and develop various symptoms such as a side to side swaying and an incoordination of the movements of the legs and possibly go down altogether, the trouble may be vitamin deficiency. A striking case of this kind developed during the winter of 1939-40 at the Dominion Experimental Substation, Beaverlodge, Alta., says Robert F. Gibson of the Sub-station staff. Twenty-four shotes on five comparative grain rations which in previous winters carried pigs through satisfactorily, were being fed as usual on open-air plank floors with A-shaped sleeping cabins. These pigs had all the winter sunshine there was. They also had mineral supplements and tankage, but they declined to eat the rather coarse, stemmy alfalfa hay offered them, so the feeding of this was soon discontinued. Up till the end of December the pigs had a little imperfectly skimmed milk.

Until near the end of January they were doing exceptionally well when suddenly, one after another, 11 out of the 24 went off their feed and off their feet, with posterior paralysis in nearly all cases, prostration and some

twisting of the body in several, and in 10 of the 11 cases peculiar head symptoms, the ears being laid back against the head and the eyes showing evidence of pain. Three of these pigs eventually died. The thriftiest pigs in the lot were the first to go down.

After holding post-mortems on several of the pigs the Dominion Veterinary Research Station at Lethbridge, Alta., decided that the underlying cause of the trouble was a lack of vitamin A and possibly of vitamin D. Improvement did not take place till the early spring, when the remaining pigs were moved out to a dirt pen and fed 10 c. c. per day per pig of Pilchardene (oil) in skim milk and all the green grass and alfalfa clippings they would eat. They made a complete recovery.

The diagnosis of vitamin deficiency squares with the more recent research in swine nutrition, which finds that fast-growing pigs on a diet deficient in vitamin A may develop marked symptoms at three or four months of age. Tankage does not contain vitamin A, but imperfectly skimmed milk, alfalfa hay, most green stuff and pilchard or cod-liver oil do contain it. The two last named also carry vitamin D. The pigs in question had been on plank floors from an early age and had no source of vitamin A except the little skim milk fed early in their lives. Vitamin A may be stored in the system but when exhausted the pig may suddenly develop peculiar symptoms. Pigs receiving skim milk would be unlikely to suffer. Under other conditions it will doubtless pay to feed pilchard or cod-liver oil.—*Press Note, Dominion Department of Agriculture, Canada.*

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EXPERIMENT STATION RECORD

EXPERIMENT STATION RECORD published by the United States Department of Agriculture is, as the name suggests, a record of experiment station accomplishments. The station material occupies half of the 138 pages in each issue. A substantial portion is occupied by the research contributions from the Federal Department of Agriculture. The remaining space is available for abstracts from non-Station and non-Department sources. In order to conserve space, station annual reports are not abstracted, as they are essentially progress reports, but all findings are enumerated. At present the major research developments in agriculture and home economics are being placed on record for the United States and Canada and other parts of the British Empire to the extent that this research is widely applicable to conditions in the United States of America. Special attention is also being given to contributions from Central and South America.

Apart from the Station and Department publications and a considerable number of exchanges, the principal channel through which material becomes available for abstracting is the Department Library. The Library receives 3,871 periodicals, according to the list published in 1936 (Miscellaneous Publication 245 of the Department of Agriculture). Another publication of value to users of the *Record* is Miscellaneous Publication 337, *Abbreviations Used in the Department of Agriculture for Titles of Publications*, (1939). This gives addresses and a key for single words which is helpful especially in identifying recent publications. These two publications will obviate many inquiries to the Office of Experiment Stations.

Copies of original publications from which abstracts are made cannot be sent as spare copies are not available. Requests for copies of Departmental publications should be made to the Office of Information. The publications of the State experiment stations are distributed by the individual institutions. Books and periodicals must be purchased from the publishers, but reprints of articles are sometimes obtainable from their authors or their institutions.

Probably the most striking development in documentation aids in recent years has been the application of photography to the making of copies. Through the operation of Bibliofilm Service by the American Documentation Institute in cooperation with the Department Library, photographic reproductions may now be obtained for purposes of research for virtually any article abstracted in the *Record*. These reproductions are available in two forms, photo-prints, which can be read without

magnification, and microfilm furnished at much lower cost but requiring a magnifier or projecting apparatus. Order blanks and details for this service can be obtained from the Bibliofilm Service, care of the Library, United States Department of Agriculture, Washington, D.C. It is believed that for certain types of articles, such as short papers appearing in voluminous or relatively inaccessible proceedings, this service has many advantages.

The classification of abstracts in the *Record* follows a plan of many years' standing. Cross references are not employed, and users are advised to read related sections: e.g. the soil conservationist should read not only the section on soil but also the sections of Agricultural Meteorology, Agricultural Botany, Field Crops, Forestry, Agricultural Engineering, Agricultural Economics and even Rural Sociology. Ultimately, the subject indexes are available regardless of sectional lines, but these indexes should not be too narrowly used.

The best method of using the *Record* as a guide to the accomplishments of the past half century is by means of the combined subject indexes. There are six of them and additions are made every five years. The second of the group covering Vols. 13-25 is no longer available, but the others can be obtained free of charge by libraries and for institutional use. The Office of Experiment Stations is always glad to help in completing files for both the general indexes and the individual volumes.—(Abstract) Editorial Article, *Experiment Station Record*, Vol. 84, No. 4, April 1941.

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INDIAN WOOLS AND GOATSKINS

INDIAN carpet wools are popular in the United States with carpet manufacturers because, compared with other carpet wools, they shrink less, have a fairly long staple and unusually good colours and therefore are desirable for the manufacture of better grade carpets. In ordinary times the bulk of the business is done through Liverpool, where brokers for American buyers inspect the bales and send samples in advance of the wool auctions. Some American importers, however, have their offices in India and buy their requirements there.

Good market in U. S. A.

A good market for Indian wools exists in the U. S. A. American carpet manufacturers are anxious to obtain Indian wools and will purchase them when possible. The future may see increased purchases of Indian wools and this would be facilitated if direct contact between the Indian shipper and American importer were established. If in the United States, e.g. in Boston or Philadelphia, there were established a wool exchange and a centre comparable to Liverpool where wool could be sent on consignment, the price of Indian wool would be lowered at least by the difference in freight costs for shipment to the United States from Liverpool, and with a decrease in prices an increase in demand for Indian carpet wools could be anticipated. The American market for Indian carpet wools can be additionally enlarged if the Indian exporter will accommodate his trade practices to the requirements and customs of the American importer and manufacturer, especially in regard to quality.

Goatskins

Another instance of American dependence upon India as a supplier of certain important raw materials is that of goatskins. The leather industry in the United States, the greatest consumer of goatskins in the world, relies almost completely on imports from abroad. About 50 million goatskins are tanned annually in the United States, a number probably exceeding the entire quantity tanned throughout the rest of the world.

The two main uses of goatskins in the United States, as linings for shoes and as shoe uppers, divides the Indian goatskin trade into two main categories—the 'Amritsars' and the 'Calcuttas'. 'Amritsars', which are used for linings, usually account for a little more than half of the United States total imports of goatskins from India. Moreover, the United States takes practically all of India's exports of 'Amritsars'. The popularity of these skins, which are of inferior quality as compared with 'Calcuttas', is due to the ability and willingness of the American tanners to work this inferior product. Because of this, the most important consideration in the purchase of

'Amritsars' is price, although, of course quality remains an important consideration.

'Calcuttas' are used for shoe uppers and therefore face different problems. While the demand for shoe linings remains comparatively stable, demand for kid leather for 'uppers' depends largely upon the vagaries of fashion. For example, during the closing months of 1939 and the beginning of 1940 suede leather was more popular for women's shoes than kid, resulting in a poor market for 'Calcuttas'. 'Calcuttas', therefore, face the constant possibility of substitutes such as gabardine, or Java and Nigerian kid, especially since the tendency in the United States is to keep shoe prices stable and if necessary to change the materials used for 'uppers' rather than raise the price. 'Calcuttas', unlike 'Amritsars', are bought for quality and price becomes a secondary factor, although abnormally high prices invite the use of substitutes. The market for 'Calcuttas' in the United States is thus not as stable and dependable as the market for 'Amritsars'.

India is by far the largest single source of supply, contributing as she does, more than one-third of American imports of goat and kid skins.

The U. S. A. provides a market for more than half of India's total exports of goatskins and the prospects of retaining this market are very promising since these imports are directly related to the American shoe industry, one of the most stable industries in the United States.

In spite of the strength of India's position in this respect, however, a recognition of the peculiar needs and demands of the American market, such as the demand for larger skins and the necessity for the introduction of a system of standardization and grading in India, would help to eliminate disputes which occur from time to time in this trade and thus promote better and more mutually satisfactory relations between the Indian exporter and the American importer. The preliminary steps taken in India in this direction are promising and should be followed up till a satisfactory system of standardization and grading is established.—*Report on the Work of the India Government Trade Commissioner, New York, during 1939-40* by H. S. Malik, O.B.E., I.C.S.

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MILK TREES

VENEZUELA possesses a 'milk tree'. It is described by Humboldt as a kind of strange fig tree which yields an abundance of rich, perfumed milk worthy of a dairy shorthorn or a Pyreneean goat.

Africa, like America, has also its milk-tree. This is the strange *tabaya* and is analogous to Humboldt's tree. This also produces an abundant supply of white opaque milky sap of exquisite flavour.

But let us return to America and penetrate into the forests of British Guiana. Here is found the most astonishing and most productive of milk-trees. The natives call it the *hya-hya*, which means sweet-sweet. Sweet and unctuous is the remarkable milk which flows, or rather runs from this tree, which the natives have surrounded with a religious cult. For them the milk of the *hya-hya* is more than a refreshing drink. It is as nourishing and as substantial a food as cow's milk, and has the same sweet odour and strengthening qualities. The *hya-hya* usually grows on the banks of lakes and rivers. Its trunk holds so much 'milk' that when it is tapped the milk flows for nearly an hour.—*Dairy News Letter.*

New Books and Reviews

Provincial Debt Legislation

By N. G. Abhyankar (The Federation of Indian Chambers of Commerce and Industry, New Delhi, 1940, pp. 102, Re. 1 or 1*s.* 6*d.*)

Mr N. G. Abhyankar's monograph is an excellent resumé of debt legislation passed in the different provinces in the decade following the agricultural depression of 1929. The defects of such legislation have been also examined critically and certain improvements indicated. It would have been more helpful if this discussion were followed up by a survey indicating the effects of the new legislation on seasonal, medium-term and long-term credit based on some village surveys. Some material in this respect is already available.

The present debt legislation in India, which only provides for compulsory scaling down of debts and rate of interest and application of a moratorium, and too greatly sacrifices the creditors without making any arrangement for the financial recovery of the bankrupt cultivators, aggravates the crisis of agricultural indebtedness. In the debt relief legislation in many agricultural countries in Europe importance was given as much to the adjustment or conciliation of debts as to the conversion of loans guaranteed by mortgages on farms with a view to the repayment of debts to creditors by instalments over a series of years and contribution by the state towards the repayment of instalments and the payment of interest. Such a line of attack on indebtedness is unknown in India.

In the concluding chapters the writer pleads for the establishment of land mortgage banks, marketing boards and a general increase of the efficiency and diversification of agriculture. Improvement of rural credit and production touches the whole social and agrarian system, and piecemeal legislation is not only futile but may even be economically dangerous. Mr Abhyankar's book, though concisely written, is clear and bold in its outlines and gives a vivid idea of the magnitude of the task which awaits the provincial Governments for finding out the real cure for the chronic indebtedness of the cultivators. [R. K. M.]

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The Grasslands of the Argentine and Patagonia

By William Davies (Bulletin No. 30, Herbage Publication Series, Imperial Bureau of Pastures and Forage Crops, Aberystwyth, 1940, p. 46, 2*s.* 9*d.*)

In this bulletin is published the report by Mr William Davies, Senior Grassland Investigator, Welsh Plant Breeding Station, Aberystwyth, of his tour of South American grasslands. The object of Mr Davies' tour was to study the present condition, and the potential and immediate possibilities of improvement of the grasslands of the Argentine Republic. For this purpose he travelled across the Republic in a south to north direction covering a vast distance in a short time. In all, 23 grass farms (stations) were visited, sufficient to give him an idea of the existing conditions. Even though it was not possible for him to survey the country in greater detail, the tour has furnished much information of importance.

The report of Mr Davies gives a short description of the climatic and geographical conditions of the Republic, which, because of its situation in a north to south direction, includes a variety of climates. The southern third of the Republic, which covers a greater portion of Patagonia, and which is situated in the cold temperate region and is arid for a greater part of the year, is mostly under sheep ranching. The Argentine proper, in which is situated the La Plata Basin, has a mediterranean climate, and as such is of

considerable agricultural and pastoral importance. Both cattle and sheep are maintained, but cattle are more important than sheep. In the northern portion, having a sub-tropical climate, chiefly cattle are reared.

The Argentine Republic is the leading lucerne-growing country of the world and had over 13,000,000 acres under it in 1933-34. The peak production was during 1920-21, when there were over 20,000,000 acres under lucerne. According to Mr Davies, even this does not appear to be the limit to which its cultivation may be extended. It is pointed out that the province of Buenos Aires and adjacent ones possess potentially the richest grazing land in the world, and it is significantly remarked: 'Were this land to be properly developed, it has the potentiality of vast output as a reservoir of human and animal food.' But Mr Davies states that if such a development takes place, it would set up serious competition with the agriculture and livestock industry of Great Britain, the British Dominions and Colonies, particularly Australia and New Zealand. At present the livestock industry in the Argentine is restricted to cattle feeding, but the dairy side, which is still undeveloped, has not materially competed in the past with Australia and New Zealand. It is pointed out that the province of Buenos Aires if properly planned could be organized into an intensive dairying and fat lamb producing area. With the soil and climate possessed by the Argentine, the potentialities for organizing dairying industry are so great that it would require very little, if any, outlay beyond the mere application of the technique of grassland improvement practised in Great Britain and New Zealand.

The remaining part of the report is devoted to the general consideration of eight zones into which the grasslands of the Argentine Republic have been divided. The possibilities of improvement and methods to be adopted with respect to each zone is given. In the latter part of the report are published detailed notes on 23 stations visited by Mr Davies.

A large number of photographs, a map, a glossary of common plant names and figures relating to stock and crops have considerably enhanced the value of the report. [L. S. S. K.]

ANNOUNCEMENTS

THE following new publications are announced by the Imperial Agricultural Bureaux:

The Rothamsted Field Experiments on the Growth of Wheat

By Sir E. J. Russell and D. J. Watson (1940, pp. 163, 7*s.* 6*d.*)

A full and up-to-date account of the famous 98-year-old continuous-wheat experiment on Broadbalk field, and of other long-period experiments on the growth of wheat in rotation, on the results of which present-day practices in the use of artificial fertilizers are largely based.

Bibliography of Soil Science, Fertilizers and General Agronomy, 1937-1940

(1941, 25*s.*)

The third volume of this series contains some 7,000 classified references with full indexes. The book will also serve as a cumulative subject index to Vols. I to III of the Soil Bureau's abstract journals, *Soils and Fertilizers*.

The Efficiency of Farm Animals in the Conversion of Feeding-stuffs to Food for Man

By I. Leitch and W. Godden (1941, 3*s.* 6*d.*)

The efficiencies of cattle, sheep, pigs and poultry in the production of milk, meat and eggs are compared. Efficiency is calculated in terms of dry matter, digestible feed constituents and edible human food. The calculations are based on accepted feeding standards and on experimental and practical rations.

Potato Collection Expeditions in Mexico and South America

By J. G. Hawes 1941, 3s.)

The bulletin embodies a full description of this expedition and of a subsidiary expedition to Mexico undertaken with the same objects. A full account is given of the itinerary, of the conditions in the countries visited, of the methods of native potato cultivation,

and of the utilization of the potatoes by the natives in the preparation of *chuno* and other productions, the different countries being dealt with separately, since conditions vary from one to the other.

New and Promising Varieties recently described in the Literature (Third List), 1941, 1*s*.

Haricot Beans

By G. St. Clair Feilden (1941, p. 20, 1*s*.)

This bulletin has been compiled at the request of the Ministry of Agriculture, London, to help those intending to grow haricot beans for private or commercial purposes in Great Britain.

From All Quarters

AN UPHILL TASK

MR S. Solomon, I.C.S., Director of Development, Orissa, sends us the following letter from Dr E. Gordon Wilkins and Dr Honor E. C. Wilkins of the Baptist Mission at G. Udayagiri, Ganjam district. Though it was not originally intended for publication, the account it gives of the difficulties to be met with in improving hill cattle is of public interest.

We should like to add that the appeal of Dr Wilkins to save the farm has met with success and the farm has been for the time being saved by a donation of Rs. 200 from H. E. the Governor of Orissa's discretionary grant. This is what they write :

We started our Hospital Dairy Farm at the Baptist Mission, G. Udayagiri in 1936 with the twofold object, firstly of providing milk of reliable quality and cleanliness for patients in the hospital, and secondly of seeing what could be done for the betterment of the live-stock of these hills, both by breeding and by the cultivation of fodder crops. We had no funds with which to start this venture. We built the houses which you have seen and bought local hill cows with money raised among ourselves. After an initial period of disappointments and disasters (including a rinderpest epidemic) we felt that in 1940 the farm had really established itself. The herd was inoculated against rinderpest and tuberculin tested by the Veterinary Investigation Officer. Nearly 3,000 pints of milk were distributed among hospital patients during the year, averaging 8 pints daily. (It should be remembered that the hill cows are very small and, even with feeding, yield no more than one or two seers daily. A cow yielding one seer a day is locally considered a good milker and the *gowalas* who tend vast herds of scraggy animals are content with merely a few ounces from each.) This was bought by the hospital and though the finances of the farm were precarious, we were just able to meet expenses and close the year with a small balance.

Incomplete oestrus

During the five years we have gained considerable experience. We have kept records of the coming into heat and service of cows and the births of their calves and have made some interesting observations. We have some evidence that cows only come into heat during the months when fodder is to be found. Out of 32 calvings of which we have recorded dates, 25, or 80 per cent, occurred in the six months February to July inclusive. Counting an average gestation period of nine months this means that 80 per cent of conceptions occurred in the six months, May to October, i.e. during the rains when there is grass. In our series no calves were born in November or December, and only two in January, showing that no conceptions occurred in February or March and only two in April. There has been great difficulty in getting the Government Hariana bull to serve these small hill cows. After repeated attempts one of our cows has been successfully served and given birth to a bull calf. The facts given above throw some light on this. They show that during the hot weather service cannot be expected from the bull as these cows do not come into heat. Apart from disparity in size it may be that the cows' lack of receptivity to the bull at other seasons also is due to short or incomplete oestrus, the result of under-nutrition. By the time symptoms of oestrus are observed and the cow brought to the bull heat is nearly over. But even if the Hariana bull is allowed to run with the herds it is likely that it will be forestalled by nimbler scrub bulls. It seems to us that what is needed for experimental breeding purposes is a small herd of cows kept so that oestrus and service can be properly observed. They must be rigidly segregated from village herds with scrub bulls, and adequately fed to ensure proper oestrus. Unfortunately, segregation means stall feeding, as, if cows cannot freely roam the fields and hills, they cannot get enough fodder. These conditions are fulfilled by our hospital herd except that we have not

the funds for adequate feeding. We have tried as fodder numerous locally grown crops, and have also grown for the first time in the Khond country crops of elephant grass, guinea grass, lucerne and soya bean. But we have no funds with which to carry on this cultivation.

Fodder scarcity

Last year, the later rains failed, with the result that grass dried up earlier than usual. About the same time fear of wild animals prevented villagers from cultivating their upper field crops which has resulted in great local scarcity of fodder crops such as gram and pulses. We and the Agricultural Overseer of the Government Experimental Farm have now to import our supplies of gram from Russellkonda at a much higher cost than formerly. Although we have tried to feed our cows to the limits of our resources, they have suffered from under-nutrition and have failed to come into heat. Some have continued yielding milk (though merely a few ounces) for well over a year without coming into heat. The one and only calf from the Government bull was wasting, so we had to give up milking the cow entirely, with loss to ourselves. During the last few months, the above causes have resulted in such a falling off in the milk supply that we have already a serious deficit of Rs. 115. We are dependent for income on the sale of milk. We have no reserves on which to draw and receive no help from Government or Mission sources. We shall therefore be obliged this rains to sell up our stock, thus putting an end to our whole venture.

The hill people are interested in cattle only for working purposes. We are trying by the example of dairy and hospital to encourage them to produce and drink more milk themselves. Milk is very scarce and the hospital is largely dependent on the herd for its supply. Then there are the experimental possibilities indicated above. Our farm is unique in these hills and from it valuable information on the problem of improving breeds of hill cattle may be obtained. We feel that it would be a great pity to close down at this stage though we see no other alternative unless we can get help from some other quarter.

We therefore request a grant-in-aid to enable the farm to continue. We suggest a sum of Rs. 10 per month and a lump sum grant for the clearance of our deficit, and hope that you may find it possible to grant this. We commend this to your sympathetic consideration.—E. Gordon Wilkins and Honor E. C. Wilkins.

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FRUIT CENSUS

The Fruit Census of the Peshawar Valley, the most important fruit-growing area in the North-West Frontier Province, has revealed very interesting information. The total estimated annual fruit production is about 12 lakhs standard maunds—this figure includes all types of fruits. The total annual production of peaches is estimated at 114,000 standard maunds out of which 86,000 maunds can be made available for drying. Pear production is over the half million maunds mark and of this 50 per cent is good for drying. Two regional large-scale drying stations have been organized and have started work, one at Mardan and the other at the Agricultural Research Station, Tarnab. This is the pioneer effort and the fruit-growers of the valley have an excellent opportunity for benefiting from it. The success of this will be an index for further expansion, and it is sincerely hoped that the results will lead to the establishment of a permanent fruit drying industry in the province. There is a very heavy demand for dried fruit and it is for the fruit-growers to seize time by the forelock and dry as much fruit as possible.

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GUARDING BRITAIN'S CORNFIELDS

With 12,500,000 acres under the plough this spring—$3\frac{3}{4}$ millions more than in 1939—Britain's agricultural leaders are planning how to protect her corn crops from Nazi fire bombs.

Last year Germany's air onslaught did not develop fully until the harvest was gathered in, but this year, combined with U-boat attacks on shipping, the menace to British food supplies is very real.

Among the safeguards which may be enforced is the cutting of fire-breaks or lanes,

about 30 ft. wide, across the direction of the prevailing wind. The crops, cut green, would not be wasted, but made into hay or silage. Corn stocks can be protected by setting the rows as far apart as possible. Ricks would be set at least 15 yards apart, and, preferably out in the field, to prevent enemy landings.

For dealing with outbreaks of fire, water carts would be kept filled near the standing crops, and further reserves stored in ricks or van covers supported on stakes.

Fire-fighters will arm themselves with stirrup pumps, fruit spraying machines, liquid manure carts, wet sacks and brooms cut from timber and hedgerows. Tractors will be useful for ploughing a fire-break quickly in the path of an advancing fire, and scythes for isolating small patches.

With fire-watchers, A. R. P. wardens and Home Guards in every parish, there will be no lack of manpower to safeguard the vital harvest of 1941.

MGIPC—M—III-1-88—10-10-41—1,800.

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II NOVEMBER 1941 No. 11

INDIAN FISHERIES AND THE WAR

The importance of food as a major weapon is stressed by President Roosevelt in a letter to the Department of Agriculture in which the President declared that the United States needs food reserves to 'meet emergencies which can as yet only be dimly foreseen'. He said in this time of crisis 'food is a weapon against Hitlerism just as much as munitions and food will continue to be a weapon in all efforts toward ensuring a more orderly, prosperous and peaceful world'. The President declared: 'We need not only abundant production for ourselves but for other nations resisting aggression.

'The monstrous forces of Nazism have looted the world and are ravaging many lands. Our first task is to beat down these forces and then repair the damage they have done to the best of our ability. In this process of rebuilding and rehabilitation, food will be essential,' the President concluded.

The letter was in acknowledgement of the report on the Agricultural Department's programme devised to encourage the production of pork, dairy products, poultry and other foods.—The Mail, *Madras, 13 August 1941.*

THE maintenance of a regular food supply in sufficient quantity and of a desired standard of quality both for the armies in different theatres of war and for the large military forces in the country is almost as essential for the successful prosecution of the war as arms and ammunition, for, as has been rightly remarked, an army marches on its stomach. In view of its situation and resources, India is particularly suited to meet the food requirements of the Empire and the various theatres of war in the Middle East and elsewhere. Though in a general way emphasis has frequently been laid in these columns on the importance of developing the different agricultural industries of this country, the time has come when a more definite effort for conserving and developing the food resources of India should be made.

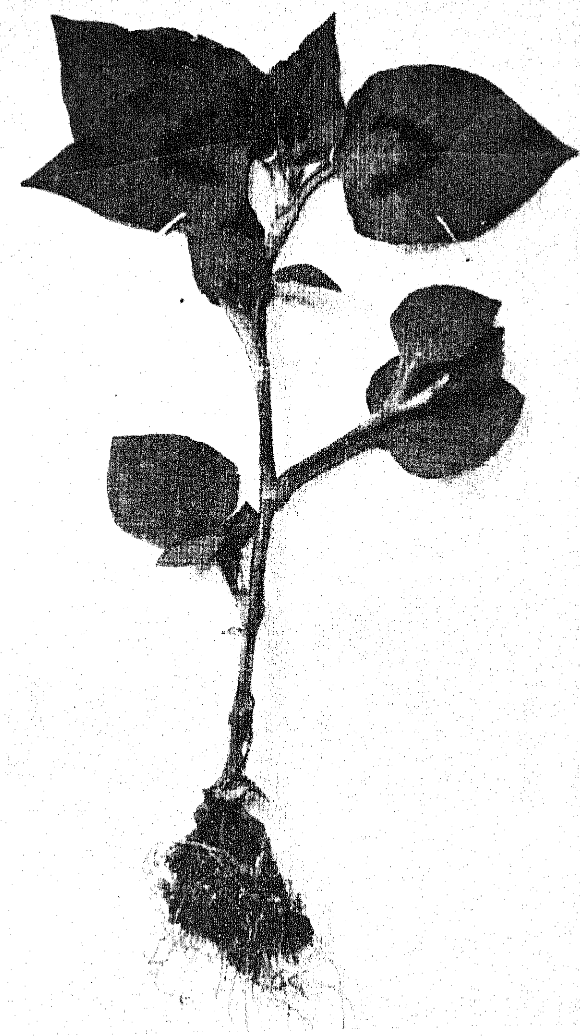
Fisheries, even in their present disorganized condition, constitute the third most important industry of India, the other two being agriculture and livestock. The value of fish as an article of diet needs no emphasis. Fish form a specially valuable addition to a diet the staple of which is rice, for they not only provide animal proteins of great nutritive value, but also fats rich in vitamin A, the deficiency of which in the average diet of the Indian villager is probably responsible for much of his sufferings.

That a great deal of immediate improvement can be effected in the shore fisheries of India by bringing to the notice of the tradespeople the prospects of better business and by encouraging and, if necessary, subsidizing development is clear from the results of the scheme of transport of fresh fish by motor-vessels recently introduced by the Bombay Government. In spite of the poor docking

facilities available for the landing of fish in the Bombay harbour, the fish supply of the town has, as a result of this arrangement, increased very appreciably. Similarly, when, owing to the cessation of Norwegian supplies of cod-liver oil, urgently required for military and medical purposes in India, it became imperative to develop the languishing fish-liver oil industry of India, within a short space of time it was found possible to develop this industry materially both in Madras and in Bombay.

Though inland, estuarine and coastal waters up to a distance of 10 to 15 miles and a depth of 5 to 10 fathoms are being exploited to a limited extent, with antiquated appliances and with an almost total disregard of the perishable nature of the commodity, the shore areas beyond a depth of 10 fathoms or so are at present receiving no attention. In this connection it may be recalled that the experimental trawlings by the *Golden Crown*, *William Carrick*, *Violet*, *Nautilus* and *Lady Goschen* around the coasts of India and Ceylon have shown that the catches of fish secured in deeper waters by these trawlers compare very favourably with those obtained in the European and North Atlantic waters. Though it is probable that the productivity of the Indian seas along different parts of the shore-line varies greatly, it has been definitely demonstrated that the fish-fauna of the Indian seas, as indeed of the Indo-Pacific region as a whole, is sufficiently rich to make further development of the fisheries by trawling or by 'purse-seiners' not only possible but practicable. In this connection it must also be remembered that the continental shelf—the natural habitat of a large number of commercially important fishes, such as cods, flatfishes, croakers, sea-basses, mullets and many others —has around India a depth varying from 45 to 100 fathoms. The Indian fisherman, as indicated above, is at present able to exploit only a narrow strip of the sea along the coast and the methods advocated above will not, therefore, in any way interfere with his vocation. It may, on the other hand, help in the gradual conversion of the 'sailing' crafts into 'power' vessels, so that the present fishing population could be absorbed in more productive undertakings, as has been demonstrated by the scheme of utilizing motor-vessels for the transport of fresh fish in Bombay waters. There is an almost unlimited harvest of the sea, but most of it lies outside the territorial limits of India. It is imperative that India should take immediate steps to exploit this source of immense wealth before foreign agencies turn their attention to it. The use of trawlers or purse-seiners, therefore, in the exploitation of Indian fisheries deserves serious consideration from the point of view of our war effort. With the full development of the shore fisheries India will not only be able to supply all the fish and fish-oil needs for the war, but also to feed properly the teeming millions of the country. The development of the fish industry will also lead to the establishment of a large series of industries connected with the utilization of fish wastes, such as maws, bones, scales, bladders, etc. and thus provide avenues of employment for a large number of people, both skilled and unskilled.

The importance of a simultaneous development of the facilities for cold storage, transport and marketing with the development and exploitation of the fisheries of India cannot be overstressed. Unfortunately at present only limited landing facilities for consignments of fresh fish are available at any of the Indian ports. In other countries, particularly the U. S. A., studies on refrigeration and on the shipping and stocking of fresh fish supplies have opened up vast markets for fishery products in the interior of the country. Considerable development of the industry can also be effected in India by the adoption of up-to-date methods of transport and preservation of the surplus quantities available by smoking, salting, canning, etc. Other countries realized fairly early that the fullest and most economical use of the fishery resources is made only when waste is eliminated, but in India unfortunately the waste in the quantity of fish caught at present is so considerable that its stoppage alone by introducing improved methods of preservation, storage and transport will perhaps supply a great proportion of the food needed to meet our present requirements.



Nature's V for Victory
A Simla plant *Polygonum alatum* of great topical interest

[PLATE 145

Rao Bahadur Y. Ramachandra Rao, M.A., F.E.S.
Late Locust Research Entomologist

[PLATE 146

RAO BAHADUR Y. RAMACHANDRA RAO

M.A., F.E.S.

An Appreciation

RAO Bahadur Y. Ramachandra Rao, Locust Research Entomologist of the Imperial Council of Agricultural Research, retired last March, after 35 years of service as an Entomologist.

Born in 1885 in the Bellary district of the Madras Presidency, he was educated at Madura and Madras, and took the M. A. degree in Zoology in 1906. Appointed Assistant in Entomology in 1906, he took his training under H. Maxwell Lefroy, Imperial Entomologist at Pusa. Thereafter he was employed on preliminary surveys of the pests of cultivated plants in various parts of the Madras Presidency and in 1913 was placed in charge of the Insectary at the Agricultural College and Research Institute at Coimbatore. From 1916 to 1919 he carried out investigations on the indigenous insect pests of lantana in various parts of India and Burma for the Imperial Entomologist and the results of the enquiry were published as a memoir of the Imperial Agricultural Department in 1919.

The same year he went to Mesopotamia as an Assistant Entomologist in the Agricultural Directorate of that country. He was responsible for a good deal of pioneer work on the insect pests of Iraq and published two memoirs on the insect pests of Iraq and the insect enemies of the date palm. On his return to Coimbatore in 1921 he was appointed Assistant Government Entomologist and in 1922 Government Entomologist, in which capacity he was responsible for such important work as the trial of biological control of the coconut caterpillar on the west coast, the introduction of Vedalia beetles to check the wattle scale, spraying for the mango hopper, the control of the red hairy caterpillar and the paddy army worm and the study of pests of cotton and sugarcane.

In 1930, Rao Bahadur Ramachandra Rao was employed by the Imperial Council of Agricultural Research to find out the permanent breeding grounds of the Desert Locust in north-west India. In the course of his work he toured extensively the desert areas of Baluchistan, Sind and Rajputana and the results obtained led to the establishment of research and observation stations in the breeding grounds. He was placed in charge of the entire Locust Research scheme in 1933. He wrote up the results of the locust research financed by the Imperial Council of Agricultural Research up to 1939 in the form of a comprehensive monograph which is in the press and will be published shortly.

Rao Bahadur Ramachandra Rao attended the Third International Locust Conference at London as a delegate from the Government of India. He was president of the Entomological Section of the Indian Science Congress in 1940. The title of 'Rao Sahib' was conferred on him in 1920 and 'Rao Bahadur' in 1936.

Rao Bahadur Ramachandra Rao is a scientist who is thorough and meticulously exact in all his observation, experiment and writing. The great monograph already mentioned is an example of these qualities. Rao Bahadur Ramachandra Rao's devotion to duty and to his science never showed itself more clearly than in the way he finished that work in spite of poor health and a heart-rending bereavement. In his retirement may he continue to exercise his scientific gifts, and to find in the study of Nature the most fascinating and comforting occupation of man.

Original Articles

RURAL RECONSTRUCTION WITH A DIFFERENCE

By W. Burns, C.I.E., D.Sc., I.A.S.

Agricultural Commissioner with the Government of India

THOSE of us who were present at the meeting where the Indian Society of Agricultural Economics was founded will remember Mr L. K. Elmhirst, the Founder and President of the International Conference of Agricultural Economists.

It may not be generally known that Mr Elmhirst spent several years in India and was mainly responsible for the organization of *Sriniketan*, the rural development department of Tagore's Institute in Bengal. No doubt many of his constructive ideas matured during these Indian years. Mr Elmhirst and his wife created, financed and continue to run in England one of the most interesting agricultural and social experiments of modern times. This has been shortly described by Mr Elmhirst himself in an article entitled 'Faith and Works at Dartington' which appeared in *The Countryman* and was reprinted as a separate pamphlet in 1937. A more detailed and well-illustrated guide book is that by Nigel de Grey (1934) entitled *The Dartington Hall Experiment*.

Estate with a history

Dartington Hall, Devonshire, is an English estate with a long history. It was in 833 the first recorded Saxon settlement west of Exeter. In 1068 it was the gift of the Conqueror to William of Falaise, then for three hundred years the home of the Martins, later the gift of Richard II, first to the Earl of Oxford on condition that he made peace in Ireland, and in 1390, to his own half-brother who laid out a fourteenth-century country palace for hunting, jousting and pleasure. It was afterwards owned by Margaret, Countess of Richmond, exchanged by Admiral Champernowne for an abbey, and kept in the hands of his descendants till 1925, when it was acquired by Mr and Mrs Elmhirst and here they started their experiment in rural reconstruction.

New lines of development

Their aims are expressed by Nigel de Grey as follows:

'If the countryside is once more to attract the worker it must offer him some, at any rate, of the advantages of urban communities. There must be fair wages, opportunity for advancement, contact with men and women in a variety of occupations, education taken in its broadest sense. Under present conditions the country labourer has little opportunity to talk to any but his fellows, the folk he meets at the village 'pub'. The outlying farmer's rare days off his farm take him to market, where he meets his fellow farmers. He has no chance to come up against men engaged in other professions, and so to get the clash of ideas, the sharpening of interests and wits that is so essential a feature of town life.

'Then, again, if the countryside is to prosper, it must attract money—the sinews of every campaign—and if it is to attract money it must be made to pay.

'With great clarity of thought they realized that this must be no effort to put the clock back. It must be a development along new lines, according with modern conditions and modern thought.

'This, then, was the task to be tackled. The estate must be developed. For that the latest results of scientific research in agriculture, horticulture and forestry must be used. Rural industries suitable to the district must be started. Centres of culture and recreation must be founded to show the way to the creative use of leisure. Everything

that could aid in setting the wheels turning in rural England must be encouraged. Lastly, it must be shown without equivocation that it could be made to pay and that for two reasons.'

Business proposition

'Firstly, this experiment was to show existing landowners (or, in the event of political changes, the Nation as landholder) how an estate could be managed as an economic proposition; secondly, since the financing of any such scheme takes capital, that an estate should be as good an investment as the manufacture of soap, motor cars or any other commercial enterprise.'

From 1925 to 1927 experts were consulted, the soils of the estate were surveyed, local conditions and markets were examined, the personnel was selected, the buildings were put in order and new ones were erected, the gardens were resuscitated and a definite plan of action was prepared. Since then the venture has gone on from strength to strength.

To quote Nigel de Grey again:

'The Estate itself with its various departmental activities has been made into a Limited Liability Company. From that Company again depends a sub-company—Staverton Builders Ltd., and its sub-company, Devon Electric and General Services Ltd. Another company has recently been formed for land development—Churston Development Co. Ltd.

'Dartington Hall Ltd. may be compared with any ordinary manufacturing and trading company, with this difference only, all profits are payable to the Trustees for their use in furthering the purposes of the Trust—education and research. The plan was from the outset a ten-year plan, four to five years to carry out necessary research, to design and construct an economic unit, two to three years to bring that unit to full production, and two to three years to learn how best to market that full production.'

Help of modern science

Every possible help of modern science has been employed in the working out of suitable systems of agriculture and animal husbandry, in the combating of diseases, in the organization of markets and for the health of the people on the estate. Up to the outbreak of the present war, things were going well and there was no reason to doubt that most of the enterprises would reach a paying basis. Economic returns, however, were never the main objective, but merely the hoped-for practical result of an orderly and well-thought-out scheme. When the war disrupted and disorganized all normal activities, Dartington, because of its organic structure and outlook, was immediately able to readjust itself to the special needs of the war crisis. The various schools did not close down. The agricultural, dairy and poultry departments increased their productivity. The whole estate is now being utilized for the accommodation of a very large number of refugee children from London and Plymouth.

The following statement from Nigel de Grey's book may be of interest:

'The Estate of 1,260 acres farmland and woodland, with its additional woodlands of 1,777 acres, employs 846 men and women. It has 125 houses upon it, 16 school and in-industrial buildings, and over 4,000 active customers. All classes of workers have been brought together and recreational facilities that they can enjoy in common have tended to bring them into closer contact.'

Care for the soul

The title of this article is 'Rural Reconstruction with a Difference'. One great difference is the emphasis on education and on art, upon music, drama and dance, on something for the souls as well as the bodies of the people.

That such ideals are not confined to one prophetic pair is shown by articles recently written by Mr H. J. Massingham in the column headed 'A Countryman's Journal' in *The Field* of May 3 and May 10, 1941. He there describes work imbued with a similar spirit by Mr Rolf Gardiner of the Springhead Estate near Shaftesbury in Dorsetshire. Here certain ancient estates have been rescued from dereliction and restored to fertility in seven years. In this process, a great part was played by an admirable system of composting, by scientific rotation, by skilful

mixed farming, by proper utilization of woodlands, by the production and processing of the estates' own feeding stuffs for man and beast. But in addition there have been reawakened old festivals and rituals intimately connected with the seasons, reasserting continuity with the past, giving expression to the artistic side of human nature and developing a community spirit. Massingham sums up his impressions of this experiment as follows :

'In the Springhead work of reclamation and self-sufficiency on the land, in the pageantry of the seasons enacted by the villagers, in the land settlement and land service aims of the Ring*, in the devotional aura that embraces the whole concept, I discern a new synthesis and integration. Here is nothing precious, or piecemeal, or mechanized, or hide-bound, nor has it been tainted by the futile intellectualism and left-wing dogmas of the age. It is a new regional growth arising spontaneously from our native earth and spreading its blossoms of faith and redemption into this present world of savagery and chaos. It lifts its shoots from the fibres of our national being; it is spiritual and practical; it is old and it is new; it is many-sided and it is vested in a genuine local community. May there not be here the self-conscious, self-acting cellular unit of the England-to-be ?'

These are signs of the times. Is it too much to hope that this spirit may spread and that such ventures may multiply in many countries ?

* An organization for carrying out rural reconstruction at Springhead.

THE STORAGE AND TRANSPORT OF FOODSTUFFS

By D. V. Karmarkar, M.Sc. (Bom.), Ph.D. (Bristol), A.I.I. Sc.
Senior Research Assistant, Cold Storage Research Scheme, Kirkee

THE food supply of a country must be well distributed. In an extensive country like India, the places where a particular commodity is produced are often far away from the places where it is mainly required for consumption and a uniform and regular distribution is not possible without proper means of transport. This is not difficult with the non-perishable class of food such as grain and sugar. These food materials can easily be stored at the place of production or of demand if necessary precautions are taken to prevent damage in storage done by rodents, ants, insects and damp and to avoid extreme conditions of environment.

Problem of perishable food

The storage and transport of perishable food call for special attention. Efforts have been made from prehistoric times to store or preserve perishable food. The methods of preservation used by the ancients were drying, smoking, salting, etc. These methods are in general use even at the present day. Dried fruit, salted fish and candied fruits are all to be found in the market. To store such prepared materials in good condition, it is only necessary to keep them away from moisture by using a moisture-proof wrapper or container. When the packing is well done, there is no difficulty in transport.

The canning industry has developed enormously during the last hundred years or so. Many perishable articles are preserved in cans and bottles. If the containers are carefully packed there is no transport difficulty and they can be taken to any part of the globe. Canned products have been a great boon to explorers and expeditions. In times of war, the main supply of the army rations consists of canned food. For the storage of canned food, a high temperature and a humid atmosphere should be avoided.

Advantages of cold storage

Another method of storage called cold storage has developed rapidly during recent years and it offers the advantage that the commodity does not require any treatment, except placing at low temperature and hence no distinct change takes place in its condition. It is a common observation that certain perishable foodstuffs such as meat, fish, fruits and vegetables keep in good condition longer if stored in cool places where the temperature is lower than the ordinary room temperature. Natural ice or snow has been used for storing purposes in many countries. It has now been possible to obtain low temperatures under all sorts of climatic conditions by the use of refrigerating machinery which has been considerably developed during the last 75 years.

There are two methods by which a perishable article of food can be cold-stored : (1) in chilled condition, or (2) in frozen condition. Articles such as meat and fish can be kept for a relatively short time only in a chilled condition but can be kept practically indefinitely when stored in a frozen condition. Again, the freezing operation can be accomplished in two ways, slow freezing and quick freezing. A 'quick-frozen' product is usually superior to the product preserved by means of a 'slow freeze'. Fruits and vegetables cannot be preserved in a fresh condition at a temperature much below 32°F as on thawing the tissues break up and the fruits and vegetables assume a collapsed appearance. They can, however, be preserved in a frozen condition for ultimate use in the preparation of jams, jellies, ices, etc.

Meat and vegetables

There is a difference between the storage of articles like meat and fish on the one hand, and fruits and vegetables on the other. The

former food materials consist of dead tissues and the exact temperature of storage, as long as it is low enough to stop any undesirable changes, is of no great importance. In the case of fruits and vegetables, however, the tissues are living and the different physiological processes are still going on. These processes are sensitive to temperature and so the actual storage temperature is of great importance. Each kind of fruit or vegetable has its own range of suitable storage temperatures. Thus, for example, apples can be best stored at 32°F, oranges at 40°F, but the mango is chilled below 45°F, and for bananas a temperature of about 52°F is too low for storage.

Refrigerated gas storage

The composition of the atmosphere in a cold store is very important and affects the storage life of the produce kept therein (Plate 147). In the case of beef, the presence of carbon dioxide in the atmosphere has some fungicidal action and also prevents oxidation of the fat which affects the bloom. It has been found that the presence of 10 per cent carbon dioxide increases the storage life of meat and it has now become possible to transport beef from New Zealand to the United Kingdom in a chilled condition. The carbon dioxide produced in respiration of the living cells of fruits and vegetables in storage steadily increases the content of this gas in the storage chamber, if the latter is gas-tight. The presence of carbon dioxide up to a particular concentration has been found to be beneficial but amounts higher than this limit may affect the quality of the produce adversely. A new method of refrigerated gas-storage requiring a careful control of the composition of the atmosphere has now been developed and is extensively used commercially for apples in the United Kingdom. Research is actively going on in its application to other commodities. The Imperial Council of Agricultural Research has recently started investigations at the Cold Storage Research Scheme, Ganeshkhind, Poona, on the possibilities of gas-storage for Indian fruits and vegetables.

When articles of food can be successfully cold-stored, it is absolutely necessary to have proper arrangements for their final transport to consuming centres under reduced temperatures. Facilities for refrigerated transport of perishables must go hand in hand with the development of cold storage facilities if proper distribution and an expansion of the geographical area of distribution are to be achieved. The facilities for refrigerated transport of perishables have been responsible for the development of a world-wide trade in perishable foodstuffs. Beef from Argentina and New Zealand is now available in the London market. The fruit supplies of the United Kingdom come from South Africa, Canada and California. The banana trade of the West Indies can only be described as an example of the romance of the development of the fruit trade as a result of artificial refrigeration (Plate 147).

This world-wide trade is wholly carried on by steamers on which it is not a great difficulty to provide for low temperatures. A refrigerating unit can easily be placed on board the steamer with only minor internal structural modifications. Railways are the most important means of transport in India. The provision of facilities for low temperature transport on railways has been found to be difficult and a number of experiments have been made. Insulated railway vans using water ice and recently 'dry ice' are being used at present (Plate 148). Experiments on the construction of mechanically refrigerated railway cars have also been carried out. In India, this question has only recently been taken up and the railways are trying to find out a suitable type of van for use in this country. The marketing staff of the Imperial Council of Agricultural Research is at present studying the transport problems of some fruits such as peaches and grapes.

Royal Commission's views

The marked absence of cold storage facilities in a tropical country like India was commented upon by the Royal Commission on Agriculture in India. The Royal Commission expressed the hope that this development would sooner or later take place in the country and suggested that cold storage research work should be undertaken. In 1934 the Imperial Council of Agricultural Research started the

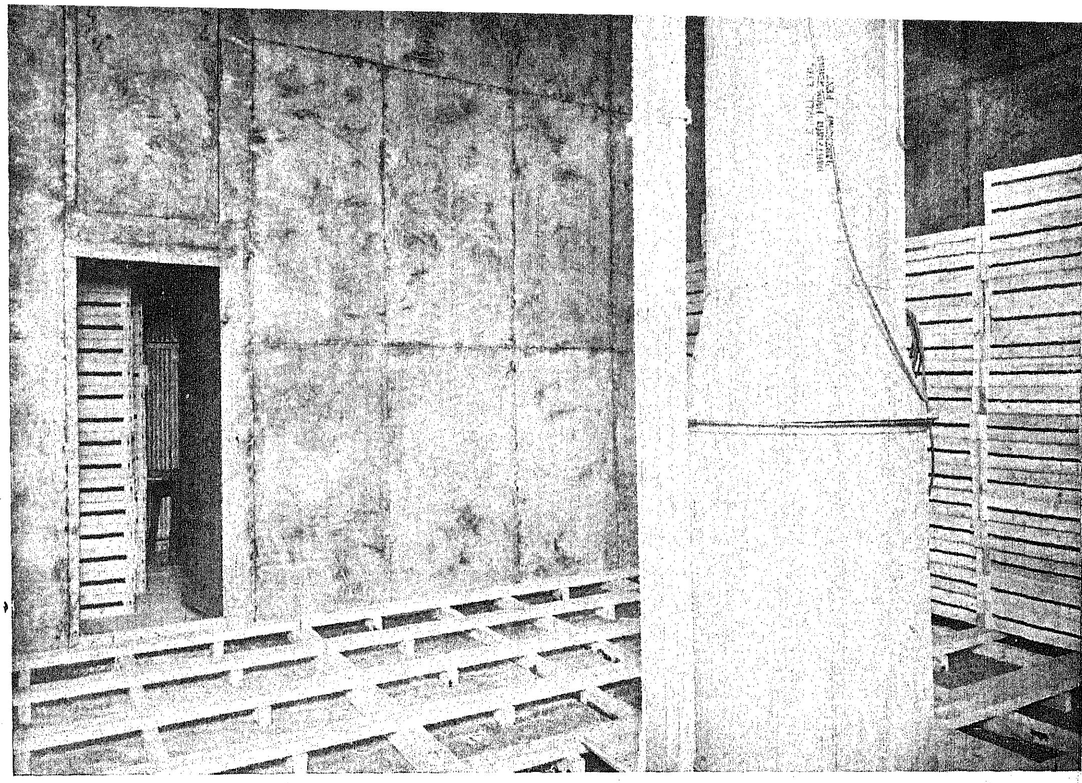
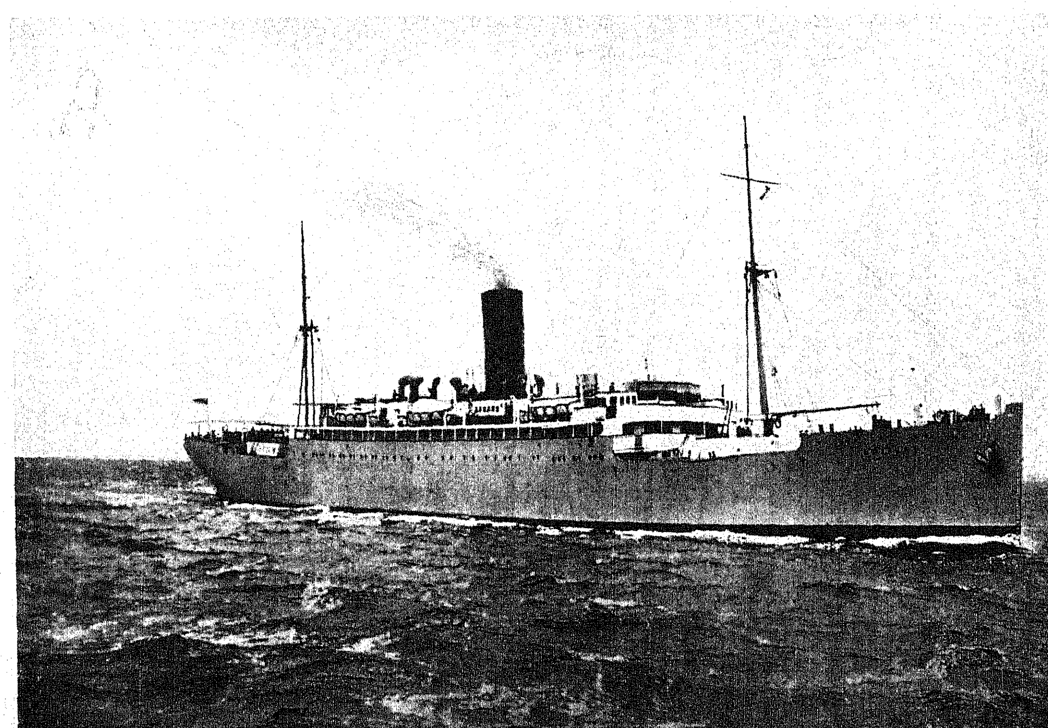


FIG. 1. Interior view of a gas store
(*By courtesy of Messrs J. & E. Hall Ltd., Dartford, Kent*)

[PLATE

FIG. 2. A banana carrying steamer ; Capacity 120,000 bunches
(*By courtesy of Messrs Elders & Fyffes Ltd., London*)



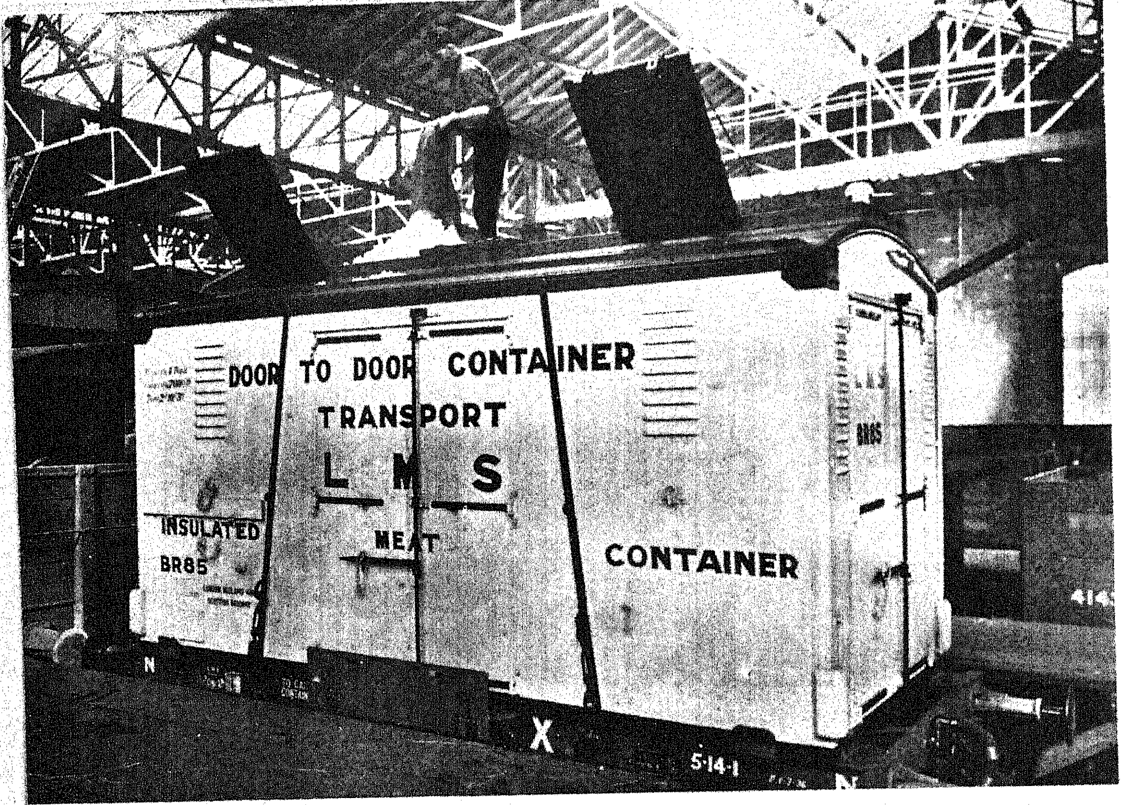


FIG. 3. Refrigerated Railway Van
(*By courtesy of L. M. & S. Ry., London*)

G. 4. Air-lock corridor and storage chambers at the Cold Storage Research Scheme, Kirkee

Cold Storage Research scheme at Kirkee where the problems of the cold storage and gas-storage of fruits and vegetables are being studied at present (Plate 148). Some of the results of the investigations conducted at the station have been published by the Imperial Council of Agricultural Research in their journals or as miscellaneous bulletins.

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CATTLE OF THE KOSI REGION IN BIHAR

By

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and

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THE Kosi is an ancient river which, on emerging from Nepal, flows through the north-western part of Bihar, meeting the Ganges above Bhagalpur. The Kosi region comprises the eastern portions of the districts of Purnea, North Bhagalpur, North Monghyr and part of Madhubani (Darbhanga). The area is approximately 80 miles north to south and 100 miles west to east. It is notorious for epidemics such as malaria, *kalazar*, ankylostomiasis and cholera in human beings, parasitic diarrhœa, rinderpest and hæmorrhagic septicæmia amongst bovines.

It is an important exporting tract for bull calves and bullocks. The soil and climate are suitable for luxuriant growth of grasses throughout the year. Animal industry in this region has great possibilities.

On account of the wide variety of grasses and abundant water, buffaloes thrive here. Their milk yield varies between two to five seers a day and they are used as dairy animals. A large number of buffaloes from neighbouring places and south Bihar are brought to this area for grazing from November to May.

Cows rarely yield milk exceeding one seer a day and are not treated as dairy animals. People keep large numbers of cattle primarily for manuring the lands that are reclaimed after the Kosi changes her course* and for raising calves for sale. A well-to-do farmer will keep several hundreds of them. They have to subsist on grazing. The calf remains with the mother and sucks the milk. Though small, the calves are quite sturdy and well-built and fetch a decent price. The problem of developing the cattle of the Kosi region may be considered under several heads :

(1) Control of diseases.

(2) Improvement of grazing areas.

(3) Improvement of the dairying industry and the economic value of animals.

(4) Improvement of stock by better methods of breeding.

Control of diseases

When animals congregate in a particular area from so many different localities, it is to be expected that they will carry rinderpest infection from one source or another and spread it amongst healthy animals. This is what actually happens in the grazing areas. Buffaloes are the worst sufferers, being most susceptible and being over 90 per cent of the animal population in those areas. Veterinary staff is inadequate, the area unhealthy, communications very bad and owners of animals backward, superstitious and reluctant to submit their animals to any treatment, as rinderpest is believed to be due to the wrath of a goddess. Protection of all the animals of the area against rinderpest with goat-tissue virus does not seem to be practical at present, and the problem of vaccination of buffaloes with goat-tissue virus has not yet been satisfactorily solved. Severe reactions accompanied by drop in milk-yield, abortion or even death are very serious drawbacks which have to be guarded against.

Hæmorrhagic septicæmia is locally called *akharhia*, i.e. a disease relating to *Akharh* (June-July). In other parts of the province it is met with more commonly after the break of the monsoon, but in the Kosi region, which

* It is known to swing east to west or west to east like the pendulum of a clock and each swing is said to take about a century. It is flowing at present towards what is believed to be the westernmost limit of her swing.

remains damp more or less throughout the year, this disease may be met with at any time of the year. In such areas the use of antiserum is hardly effective; vaccination confers immunity lasting about two months. Frequent vaccination is costly and is resented by the owners. Buffaloes are the worst sufferers from this disease. It is not known whether their mode of life has anything to do with the incidence of the disease. The possibility of preparing a more potent vaccine deserves to be seriously considered.

The Kosi region, with its enormous cattle population, provides very suitable conditions for the multiplication and development of helminthic parasites. Among the internal parasites, liver-flukes and amphistomes are very common. They cause serious loss of milk, emaciation and death. Other parasites are the stomach worms. A few more parasites are also found, including tape-worms, but they are not as troublesome as flukes and stomach worms. The area is so vast and the course of the river is so uncertain that a satisfactory scheme for the eradication of flukes does not seem to be practicable and economically feasible. In carbon-tetrachloride we find a useful drug for dealing with this menace. Both in individual and mass treatment it has given satisfactory results and stock-owners have fully appreciated its usefulness. The drug is toxic and should be used with care. Among external parasites which cause a good deal of irritation and reduction in milk-yield we find *Habar*, a small biting fly. Very numerous from March to November, it is also found during the winter. The buffaloes take shelter in water to avoid its bites. Another is *Tabanus*, blood-sucking fly common from April to October. It makes the animal, especially the buffalo, very restless. It bites only during the day. Mosquitoes are numerous and bite during the night. Some relief is obtained by burning wood and rubbish to produce smoke. The buffaloes in this region are heavily infested with lice. Cattle are also infested with ticks and fleas.

Improvement of grazing areas

Animals subsist mainly on grasses where they are abundant. *Khas* is by far the most plentiful grass found over hundreds of square miles. It grows to six feet or more on sandy beds of the river. It is relished by cattle when soft, but it begins to get coarse after February and dries up by March and April; but if cut for thatch or other purposes or burnt down, which is generally done, green offshoots come out and provide excellent fodder and grazing during the dry months. It provides several cuttings during the year and is fairly nutritious.

Danti, *Hara*, *Ori*, *Emal*, *Telarh* grow abundantly. A point of interest is that they remain small in height during the dry season, but begin to grow as the flood rises and always remain above the water-level. These grasses and especially the *Danti* are said to increase the milk-yield.

Dabhi and *Rarhi* are grasses of higher and drier regions and are eaten only when soft; otherwise they are mostly used for thatching purposes.

Doob and *Booki*—these are excellent fodder grasses and grow abundantly after the subsidence of the flood and are fairly nutritious. The plots bearing these grasses are leased out at Rs. 4 to Rs. 20 per *bigha* for grazing buffaloes, etc.

Ankata, *Pipra*, *Sosna* and *Phephna* are succulent grasses growing in abundance after the floods subside.

Garar, *Chechar* and *Patpati* are found in abundance and provide plenty of grazing. They grow to two feet or more.

There are other grasses not included in the above list. It appears desirable that the food value of all the grasses in the Kosi region be investigated and bulletins issued in the local languages for the information of stock-owners. While grass is so plentiful in most areas, there are places where scarcity of fodder prevails, especially during the flood season and this needs proper investigation.

Improvement of dairying

The disposal of the large amount of milk available offers plenty of room for improvement. Throughout the Kosi area numerous cream separators are kept. The separated cream is kept under unhygienic conditions in big jars for four or five days or even more to ripen and then it is churned by country

methods or rubbed with the hands with the addition of water to produce crude butter which is also kept exposed in some earthen or wooden trough for a number of days till a sufficient quantity is collected. It is then clarified into ghee and tinned for export. The separated milk is retailed at varying rates according to the demand, the common rate being 6 pies per seer. It is made into curd and consumed or sold. There is hardly any food which is relished so highly as curd. In some areas where the animals have come from distant places and no cream separators are available, ghee is separated by country methods. Milk is boiled—16 *chhataks* being reduced to about 14—and then it is placed in a long earthen jar where it is churned with a wooden or bamboo churner till cream is separated. For the whole business there are three sets of people. Stock-owners who produce the milk, *dahiars* who take the milk from the producers and deliver it to the machine-man and the machine-man who manufactures the ghee. The producers of milk who stay near important towns like Bhagalpur, such as Gangapur *diara*, and are perhaps better informed, get one seer of ghee for every 12 seers of milk, the *dahiars* get the skimmed milk as wages and the machine-man his hire at the rate of Re. 1 per maund of ghee produced. In some places *dahiars* and the machine-man are one and the same person with paid servants for the collection of milk. In distant places such as Jagatpur *diara* and in jungles 13 seers of milk is required for one seer of ghee. But in many places such as Chandrayan and Mehsi, the machine-man is more exacting and separates the milk on condition that he will buy the cream ordinarily at 6 annas per seer. Poor and ignorant *gowalas* yield for lack of marketing facilities.

There is a good deal of cheating and the whole business calls for investigation in the interest of the producers by the marketing department. There is also room for investigation in the methods of manufacture of cream and ghee.

Value of animals

Another consideration is the economic value of animals. At present animal husbandry provides a considerable portion of the income of this area. What will happen when the land is reclaimed for agricultural operations on the river changing its course? This point should be borne in mind while considering any scheme for animal husbandry on a permanent basis as an independent industry. The author discussed this matter with many intelligent farmers in different places, taking into account the minimum income from a buffalo and the maximum income from a *bigha* of fertile land. A *bigha* of land with a buffalo was taken as a unit. The buffalo with an average daily milk-yield of three seers and a lactation period of six months in a year would fetch Rs. 45 at the rate of 12 seers of milk per rupee plus Rs. 10, the minimum price of a calf, leaving aside the manure for the field or fuel. A *bigha* of fertile land with two crops a year will yield 20 maunds of paddy worth Rs. 40 and six maunds of some pulse worth Rs. 20, including straw and *bhusa*. From this amount should be deducted the cost of seeds, labour and the maintenance of bullocks that will amount to Rs. 5 or so. It will be seen that the animal will ordinarily yield more and the land less.

If one can maintain a number of buffaloes giving milk in rotation throughout the year, dairying must be more profitable, especially when properly organized. The chief argument against animal husbandry was that cattle would die of *akharia* (hæmorrhagic septicæmia), *gosawan* (rinderpest) and *chali* (worms), but there are factors against cultivation also such as drought, flood, hailstorm, crop pests, etc. Taking everything into consideration, the organization of animal husbandry in the Kosi region offers the best prospect of ameliorating the economic condition of the people. Many farmers seem to think a system of insuring buffaloes an economic possibility.

Cows do not offer chances of success as an independent industry. They do not do well in the flooded area but in higher regions they are in great demand for their manure to enrich the soil and as producers of energetic bull calves. Their milk-yield is negligible. There is, however, no denying the fact that the whole region, besides the manufacture and export of ghee in an enormous quantity, is

also a suitable breeding tract for buffaloes and bullocks.

Improvement of stock

If animal husbandry is to be made an independent and profitable industry, considerable attention will have to be paid to the improvement of stock. In the Kosi region, which offers good chances for success in this line on account of its natural resources in fodder grasses, the buffalo occupies a high position. People in general are nervous of keeping Murrah buffaloes as they think with some reason that this breed is more susceptible to hæmorrhagic septicæmia, rinderpest and helminthiasis besides a high initial cost in maintenance. In spite of this, cross-bred Murrahs are not unknown. At fairs they are greatly in demand and are being imported in increasing numbers. Darbhanga and Monghyr districts, where these animals are bred in large numbers, are deriving a considerable income, and it seems that organized propaganda will hasten the improvement of buffaloes in the area with considerable benefit to the inhabitants.

The present system of maintaining stud buffalo bulls in this area is very primitive and as buffaloes form a large percentage of the total dairying stock, the distribution and proper maintenance of such bulls of approved breeds should be the first step to be taken. The Murrah breed has a good reputation and will suit this province well.

It has been stated above that the milk-yield of cows is not of much consequence at present. Whatever breed is selected, local conditions will have to be taken into consideration. Stall feeding on a large scale is not practical. Here Brahmani bulls are not common, but bull calves are castrated very late. They have a belief that early castration hinders the development of the calves and lessens their agility. Bull calves are generally castrated after they have completed two teeth, occasionally when they have completed four teeth. In the meantime they serve the cows in the herd and also do plough work. The question of distributing and maintaining good bulls with a view to improving the local breeds must, therefore, be accompanied by castration of the other male stock at an early age. At the same time improvements in the quality of bullocks will enhance their value and will bring more money to the stock-owners. If the milking quality improves, the cows also may fetch a better price in the market, especially as there is a considerable demand for good cows from Bengal.

RICE IN THE TRAVANCORE BACKWATER RECLAMATIONS

By K. R. Narayana Iyer, B.A., M.Sc., F.C.S.
Director of Agriculture, Travancore

RICE is the staple food of the people of Travancore and occupies about 700,000 acres, nearly a third of the total cultivated area of the state. Still, enough rice is not produced for home consumption. The average annual consumption of rice within the state is estimated to be about 20 million cwt. Of this, local production now accounts for only about 12 million cwt. or less than two-thirds. The deficit of over a third of the total quantity to the value of over Rs. 3 crores is made up every year by imports from outside the state, particularly from Burma. To reduce this import gradually and to establish equilibrium between local food consumption and food production every possible means is being considered both by the Government and by the people.

A recent achievement in the increase of rice production is the successful reclamation of large areas of backwaters into beautiful rice fields. The enterprise is not more than 40 years old. The initiative had a non-official origin, but Government encouraged the enterprise by taking nominal and fractional value for land and putting off assessment till success was assured. When the power-engine driven both by gas and oil became available, the people of central Travancore caught the craze of backwater reclamation and today there are about 30,000 acres of such reclaimed land on which a successful crop of rice is raised.

Putting up bunds

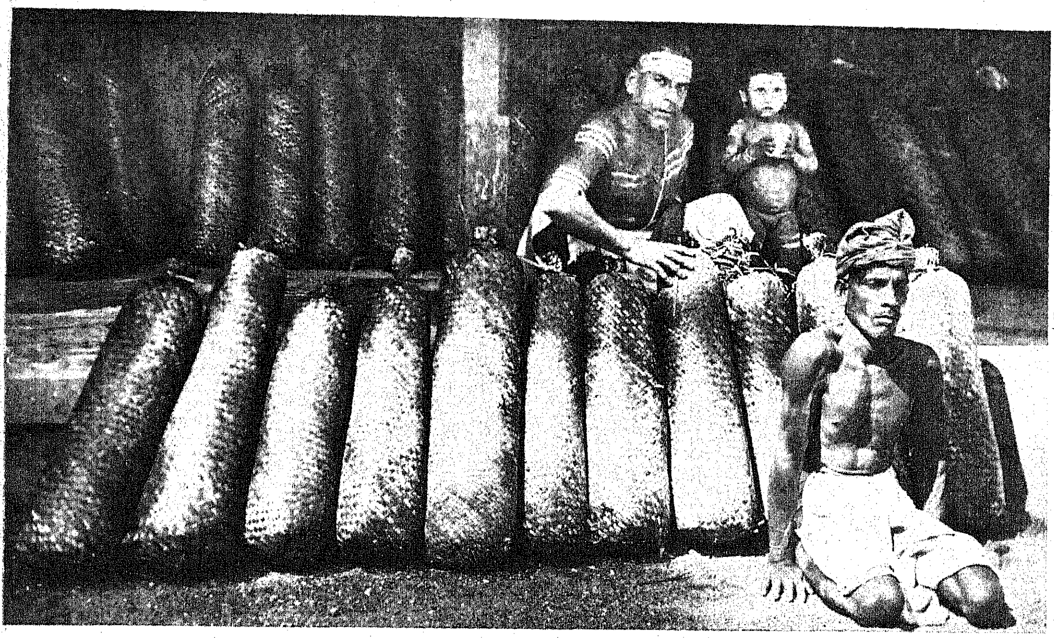
First the boundaries are marked out. Then mud, collected by diving deep into the bottom of the lake elsewhere, is brought in canoes and flung down along the line until it reaches the water level. Some time is allowed for the basis of the future *bund* to settle down. Next, piles of bamboos and coconut timber are driven in two parallel rows. The mud work is continued until the top of the *bund* approximates to a width of 10 ft. and bottom to 30 ft. During the construction of the *bund* hardy grasses and twigs of trees are freely used in between the clay lumps in order to consolidate it and render it impervious to the inflow of water from outside. For protecting the *bund* and making it resistant to wind and wave, the hardy grass known as *karakom* (*Phragmitis karka*) is grown all around it. In a new reclamation the *bunds* are put up in the month of April before the south-west monsoon bursts.

Sowing and transplanting

When the monsoon is over, that is in September, small breaches here and there are closed up and the water in the enclosed area is pumped out with the aid of an oil-engine. In the early days the Persian wheel was used, involving considerable labour and loss of time. With the inauguration of the hydro-electric project at Pallivasal in the high ranges, electric power has been made available for pumping out water with ease and economy. The pumping commences by the middle of October and is finished by the middle of November. Sowing is done immediately thereafter. The practice is to use short-term varieties such as *Kochuvithu*, *Athikkirazhi* and *Samba*, the first two having a duration of 75 to 85 days and the last about 90 to 100 days. The seeds are soaked in water overnight and then tied up in screwpine bags for a day or two when they germinate. It is the pre-germinated seeds that are generally sown. Sowing is done in about 18 in. of water and then the land is drained gradually and allowed to dry. The germinated seeds establish themselves in the mud and the seedlings grow for about 8 to 10 days under

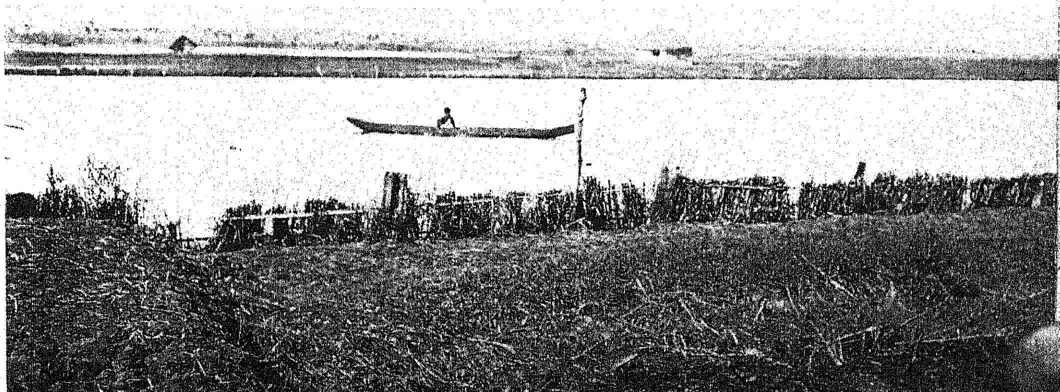
Sowing germinated seedlings

Transplanting seedlings



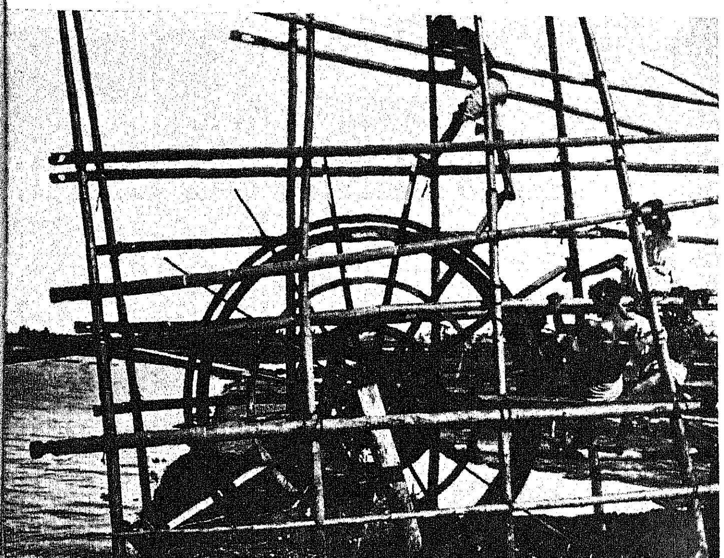
Soaked seeds kept in scr
bags for germination

Backwaters immediately after reclamation



Sweeping off caterpillars with brooms

Sweeping off rice swarming caterpillars



The Persian wheel

De-watering with the engine and pump

fairly dry conditions. Thereafter water is let in slowly according to the growth of the seedlings. Nearly four weeks pass before transplanting is started. This is done to make the plants stand even by plucking from where they crowd and planting where they are few and far between. The gaps are also filled up.

After transplanting is over enough fresh water for the subsequent growth of the crop is stocked in the field with the aid of the engine. If this is not done in time the water outside, which is connected with the sea along several bars, becomes saline on account of tidal rise which begins by the end of February and continues up to June. If cultivation is started early it is possible to wash out the acid and saline substances in the fields twice or thrice with fresh water from outside before the final stocking of the water is done. This practice is generally resorted to as it tends to increase the outturn perceptibly. Small cross-channels are provided in the fields for this purpose.

Pests and diseases

The most serious pest of the crop in the area is the rice swarming caterpillar (*Spodoptera mauritia*). The moths lay large numbers of eggs and the caterpillars march from field to field in huge swarms, devouring the tender leaves and causing heavy loss. The ryots try to control the pest by sweeping the caterpillars off the crop with a broom or a small basket with a stick attached to it. Others let in water to drown them and then pump out the water with the dead bodies of the caterpillars. Ducks are let in very often to devour them in large numbers. But under the peculiar conditions in which the crop grows, it has not been possible to check effectively any extensive outbreak of the pest.

Harvesting the crop

The harvest begins by the middle of March and ends before the close of April. Both harvesting and threshing are done by manual labour. Men and women are got down specially for the purpose from various parts of the state and settled on the *bunds* of the reclamations sufficiently early in small huts, as otherwise labour would be extremely difficult to obtain at the required moment. During this time the whole area is in a fever of activity to dodge the first downpour of the April showers and stow grain and hay away from water. After harvest, rains and floods again fill the area with water which remains from June to September.

Generally speaking, cultivation in these areas takes place only once in two years, the land being allowed to lie fallow every other year. Systematic ploughing and manuring are neither the rule nor the exception. The land is fairly fertile on account of the alluvial deposits brought down into the area by a network of rivers which join the backwaters at several places. Of late, however, as a result of intensive propaganda and demonstration conducted by the state Agricultural Department, ploughing the land immediately after harvest, liming and manuring have been adopted in some areas and the scientific method of cultural operations is gradually getting into vogue.

The average yield of grain per acre varies between 2,000 and 3,000 lb. A half of this has to be spent for putting up *bunds*, for baling out water and for the various other operations connected with the actual cultivation from sowing to harvest. The wages are always paid in kind.

Unfavourable factors

Some of the factors that militate against more successful, and annual instead of biennial, cultivation are the comparatively heavy cost of putting up the *bunds* and baling out water, the difficulties to be met with in carrying out effective ploughing and application of manure and the paucity of labourers in harvesting and threshing the paddy within the limited time available. To overcome these difficulties cheap credit facilities have been made available and electric supply extended to the very heart of the area for quick and efficient dewatering. It has also been demonstrated that topdressing the crop immediately after transplantation with an indigenous manure mixture consisting of oil-cakes, prawn-skin and ashes will materially increase the yield. To solve the problem of inadequate

labour demonstrations of the McCormic-Deering thresher and the power hay press are now in progress. A prize has been announced for the discovery of a motor plough with which the land could be ploughed under several feet of water. Several designs of such ploughs have been submitted and are under scrutiny by an expert committee. With these improvements it is hoped the reclamations will be successfully cultivated every year.

Cultivation in backwater reclamations is an extremely strenuous venture demanding initiative, enterprise and skill. If there is the slightest neglect at any time in the proper watching of the *bunds* and in repairing them immediately when part of the mud is washed away by the waves, dire calamity results. Except in certain portions of Cochin such an interesting system of rice cultivation does not seem to prevail in any other part of India.

THE LOCUST MENACE IN SIND

By L. M. Hira
Senior Marketing Officer, Sind

As far back as human history goes, locusts have been one of the dreaded plagues of mankind. Their ability to fly long distances and their propensity for making sudden onslaughts on cultivation in enormous hordes render them dangerous foes of agriculturists. Locusts, whether as flying swarms or as hoppers, are even more difficult to eradicate than their human imitators, Hitler's Nazis. Like clouds darkening the sun, the destructive pests come down, spreading ruin where they settle, and even stopping trains, as in Jodhpur recently. There are many kinds of locusts, but the Desert Locust is the most serious. This locust, otherwise called the North-West Locust, has been known to appear periodically in the past in Sind, and to cause serious damage to crops. Close observations made during the swarm-free period have shown that the locust generally lives in the solitary condition in the desert areas of southern Baluchistan and the Sind-Rajputana region. Its habits of feeding and breeding are just like those of the gregarious locust. It ordinarily breeds twice in the year but, with good rainfall, multiplies extensively, and if a second brood follows rapidly and concentrated egg-laying also occurs, incipient swarms are formed.

Timely warning

Last year the Locust Warning Organization of the Government of India, who have a locust sub-station at Karachi, and some out-posts in the desert, warned the provinces and states concerned about the sudden increase in the locust population in certain parts of Sind and the Rajputana states. Consequently scouting parties were organized by the Agricultural Department, Sind, and by the adjoining Indian states, to locate swarms and demarcate breeding places. Unfortunately, however, it appears that locusts also breed in the countries beyond the western frontiers of India, viz. Iran, Arabia, etc. Swarms, presumably originating from these countries, entered India last June and July and invaded the southern parts of Baluchistan, Sind and the Rajputana states. These immigrant swarms have been breeding on a large scale in Sind and the Rajputana states during July and August. In particular, the Desert Division of Tharparkar, having received exceptional rainfall this year, has served as a very suitable breeding place for them.

Alarming numbers

In September the pest assumed alarming proportions in all the talukas of the Desert Division and also the desert parts of Umerkot and Khipro talukas. The pest was also found in the desert parts of Badin and Moidan area along the river Hub in Karachi taluka. The first generation of hoppers was then reaching the adult stage and, unless destroyed immediately by hand or by digging trenches or by burning or by poison baits, were expected to give rise to swarms within the following fortnight, likely to invade the cultivated areas of Sind and adjoining provinces or to remain and rebreed locally in the desert, giving rise to further large swarms in October and November. The expert authorities estimated that locust activity might continue in Sind till the middle of November or even later. So the menace of both the hopper and adult stages has to be faced up to that period. The pest is spread over a vast area several hundreds of square miles in extent.

Crops in danger

Our crops in cultivated areas were in imminent danger of attack. The condition of standing crops was excellent and agricultural prices were very high. The total value

of the crop would be several crores of rupees. The Government of Sind, being fully alive to the impending calamity, has been fighting the menace with all the resources at its disposal. The Government of India Locust Organization has right from the beginning given timely warning and helped the Department of Agriculture to devise suitable control measures. The Imperial Entomologist has visited the province thrice and during his recent visit discussed with the Director of Agriculture and the Collector of Tharparkar the organization and control measures that are being adopted. He has fully approved of the action already taken and that proposed to be taken.

Measures taken

So far nearly 200 officers from the Agriculture, Revenue and P. W. Departments have been detailed to organize and supervise anti-locust work. A sum of Rs. 2,00,000 has been sanctioned for the purpose and the 'Rupee a bag policy' for the capture of locusts has been working satisfactorily. While every effort is being made to requisition local labour available in the desert, there is great need of labour from the cultivated areas of Tharparkar district, an dso far an extra labour force of more than 4,000 persons has been employed. Considerable stress is being laid on digging trenches to drive hoppers into them and then destroying them; burning in places where hoppers congregate on bushes has been found useful and is being adopted. Beating hoppers and adult locusts laying eggs has given very good results. An adequate quantity of equipment and material has been already received, and poison for control measures is being ordered and will be available for use in all these centres.

The Director of Agriculture and the Collector of Tharparkar have personally visited the locust-affected areas and are sparing no pains to check the menace.

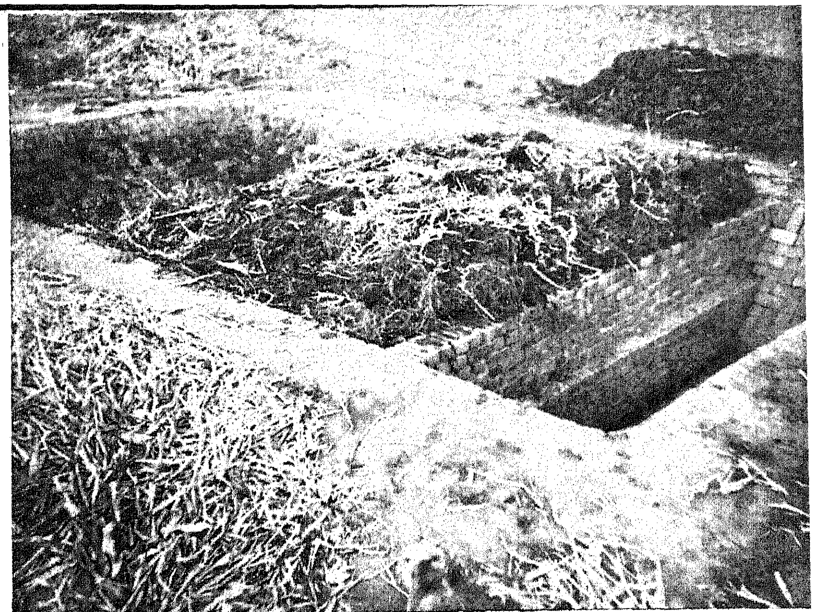
The Hon'ble Minister for Agriculture is also taking a very keen interest in the locust control work and it is hoped that his 'all-out action' coupled with extra measures which have already been taken and are to be followed up will be adequate to relieve Sind from the danger of locusts.

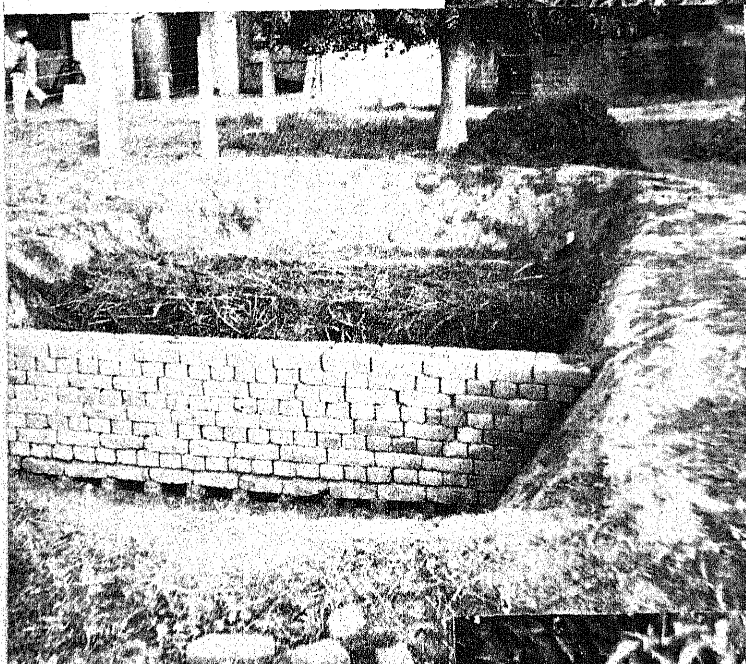
The agriculturists, however, in the meantime, are passing sleepless nights and are earnestly looking to Providence to save them from this scourge.

Their feelings are more aptly described in the following stanza (followed by many more equally pungent) written by a local zemindar:

Now are the green fields at their best,
In them has man put all his zest,
But the Devil doth at him jest,
And sends his cursed locust pest.

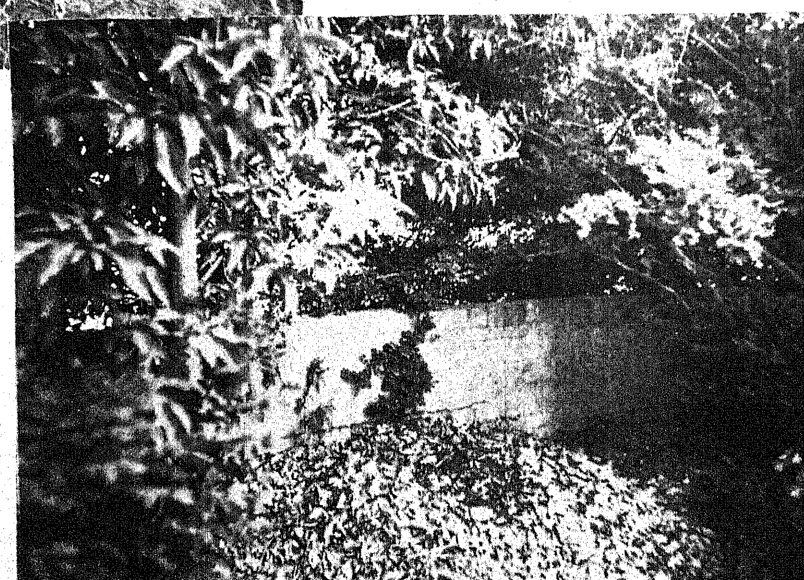
Brick-lined compost pit. Dry brick on-flat floor, supported by brick-on-edge with aeration channels between. Heap of older compost at side





Cheaper pit with earth banks and brick aeration floor

Cheap arrangement for garden. Compost lying on bamboos supported on bricks



SEWAGE SLUDGE AS A STARTER FOR COMPOST

By F. C. Griffin, M. Inst. C.E., M.I.E. (Ind.)
Engineer, Delhi Joint Water and Sewage Board, New Delhi

It is an acknowledged fact that plants, like animals, require nourishment in order that they may grow, and it is necessary to replace from time to time the chemicals which are utilized by the growing plants.

There are three essential requirements for satisfactory plant growth and each is as important as the others. The nature of the soil should be satisfactory from a chemical, physical and bacteriological point of view.

The most satisfactory way of providing for these three factors is to feed plants with some form or other of compost which is rich in humus. The composting of waste vegetable matter into a valuable manure has been extensively developed of recent years. Briefly, compost is prepared as follows:

How to make compost

The materials required for composting are (1) any form of vegetable waste, such as dry leaves, grass mowings, etc., (2) cowdung, horse litter or forms of manure such as night-soil, and (3) wood ashes. These materials are placed in layers in a compost pit (which should be arranged with aeration channels underneath). Water has to be sprinkled on each layer before the next is put on the top of it. Within a few days the temperature in the mass, caused by fermentation, rises to about 150°F. In such a high temperature all the seeds of weeds and all forms of insect life are destroyed. After 10 days the mass should be turned over and the process of sprinkling water repeated. This 'turning and watering' should be repeated at intervals of 10 days for a month, when the material is removed from the pit. The process is then continued on the ground. The compost should be completely ready for use in three months. The resulting manure is rich in humus and contains the three essential requirements mentioned above.

Those interested in composting should obtain a copy of Sir Albert Howard's book on the subject.

Use of sludge

In this mechanical age there is little that need be allowed to go to waste. In modern cities such as New Delhi, sewage is converted into a valuable manure known as sludge and this sludge can be used most effectively to replace the cowdung, horse litter, etc. referred to in the directions for composting above.

None of the complaints against crude night-soil, such as fly breeding and offensive smell, can be brought against sludge manure. At the Delhi sewage purification works the sewage of the city is put through the scientifically operated 'activated sludge' process, from which there are two residuals—purified effluent water (which is now used to irrigate about 3,000 acres of land), and dried sludge. The sludge is so treated that it cannot become a breeding ground for maggots, even after re-wetting. It is, therefore, perfectly safe for distribution as a manure, even over long distances.

The sludge is now sold in three forms: (*a*) lump digested sludge, i.e. as it lies in the drying beds, (*b*) powdered digested sludge, which is now made in the form of briquettes, thus rendering it easy for transport, and (*c*) powdered mixture of digested sludge and activated sludge.

In (*a*) and (*b*) the average nitrogen content is 1·2 per cent while in (*c*) it is 2·8 per cent. Enquiries are solicited, when full analyses can be given.

Sludge can also be used in other ways as a manure. Preferably it should be ploughed or dug into the ground and covered over

with earth. Powdered forms can be used as top-dressings, either dry or by mixing with water and throwing on as a slurry. It should be understood, however, that when sludge is again wetted there is a slightly unpleasant smell which is more pronounced with the (*c*) type sludge.

With composting, however, there is this important feature in that there is no smell of sewage, even at the commencement. The only smell is that of rotting vegetation and there is positively no sign of fly breeding. An excellent manure in the right condition to act directly as a plant food is produced by this process of composting waste vegetable matter with sewage sludge.

MANURING OF MANGO TREES: THE PRESENT POSITION

By S. C. Roy, M.Sc., B.Sc. (Lond.)

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MANURING in the case of mangoes is best divided into two parts: (1) Manuring desirable in the preparation of an orchard; and (2) the manurial requirements of the mango plants in a growing orchard.

With regard to (1), R. G. Allan in *Modern Mango Cultivation* (Bulletin No. 13, Department of Agriculture, United Provinces) gives the following information:

'The general tendency of most growers is not to provide enough manure. Manuring should be done by using leaf manure, well rotted farmyard dung or well decomposed compost or a mixture of these. Forty pounds of this per tree is not by any means excessive. Commercial orchard practices elsewhere advise as much as a maund to a maund and a half per tree, although in the last case the soils in which the trees were being planted were of lower fertility than those of the United Provinces. Another important addition to the pit contents is bone. This should take the form of bonemeal, not broken bone pieces, in quantities of between 5 to 10 lb. per pit. Again, if wood ash is available, the manure given to the tree will be improved by like amounts of this or in its absence, commercial sulphate of potash at about half the rate for wood ash.

Warding off white ants

'As recorded above, the major part of this mixture should be worked into the soil used in the lower part and rather less should be included in the soil of the top foot. To the latter, however, it is useful to mix in addition 2 lb. of *neem* cake or 4 lb. of *mohwa* cake, as these, in addition to supplying food, tend to keep away white ants, one of the chief enemies of the young orchard. It is suggested that with the soil and silt used to fill the lower 2 ft., 30 to 40 lb. coarse manure, 6 lb. bonemeal, and 6 lb. wood ash should be used while to the soil for the top foot should be added 10 lb. old manure, 2 to 3 lb. bonemeal and 2 lb. *neem* cake. The soils so treated should be returned to the pit in layers, firming each layer as it is put in. This should be completed before the rains and left to settle down under the influence of the early showers before planting is done. The sub-soil from the pit, if not used in filling because of its poor quality or the easy presence of silt, can be utilized either to level up local depressions or in constructing *thallas.*'

(2) The manuring of the growing orchard is a subject which has not received close experimental attention and it is, therefore, less easy to be definite about this. Allan, in his book quoted above, says: 'Successful manuring must ensure a good tree growth without detriment to yield and good yield without detriment to quality. The common dressing given by many growers is only 10 lb. of farmyard or leaf manure per annum per tree. This is definitely, even allowing for the fertility of the United Provinces soils, on the low side and could be profitably increased.'

Bombay practice

'The Department of Agriculture, Bombay, advises 20 lb. farmyard manure, 5 lb. bonemeal and 10 lb. wood ash at the close of the first year, with additions each year of 10 lb. farmyard manure, 1 lb. bonemeal and 2 lb. wood ash till the total per tree is 100 lb. farmyard manure, 15 lb. bonemeal and 30 lb. wood ash. If green manuring with *sanai* is done in the rains the farmyard manure can be considerably reduced, in fact almost discarded, but the minerals should continue.

'Research workers in other parts of the world vary in their opinion as to the desirability of heavy or nitrogenous manures once the tree is in bearing; but all formulæ for the manuring

of mango emphasize the need of phosphoric acid as supplied by bonemeal or superphosphate and potash as supplied by wood ash or sulphate of potash. The presence of ample supplies of these influence fruit yield, fruiting regularity and the quality of the fruit. They indicate that farmyard manure can be given in increasing amounts up to the fifth or sixth year but that after that it is inadvisable to give this except on poor soils but that the minerals are essential. Trees should receive, when the diameter of the crown is approximately 15 ft., 9 lb. per annum of a mixture made up in the proportion of 100 lb. superphosphate (17 per cent) and 15 lb. sulphate of potash or 8 lb. of a mixture made up at 90 lb. bonemeal and 15 lb. sulphate of potash given in two dressings in the year, once with the opening of the rains and again at the ploughing after the rains close. This quantity is reduced in amount or increased in proportion when the diameter of the crown is less or more than 15 ft.

In regard to the United Provinces, the heavy manurial dressings advocated in Bombay seem too large.'

U. P. recommendations

Mr Allan suggests the following :

'(i) 10 lb. farmyard manure, good leaf mould or compost increasing in 10 years by 3 lb. to 5 lb. per annum to 40 lb. or 55 lb.

(ii) 3 lb. *neem* cake increasing in 6 years by ½ lb. per annum to a maximum of 6 lb.

(iii) 3 lb. superphosphate or bonemeal and 1 lb. of sulphate of potash increasing in 10 years by ¾ lb. up to a combined maximum of 12 lb.

'If the general growth of the trees is too vigorous after definite fruiting has been established, (ii) of the above can be cut down or withdrawn. All manuring of a mango tree should be done in a ring or if inter-cropping is done, a square round the tree, starting the ring or the square with its inner edge 1 ft. from the tree and increasing this from the tree by 6 to 9 in. in accordance with tree vigour further from the tree each year or so as to lie 1 ft. or 1 ft. 6 in. inside the crown of the tree. The manure should be applied in a trench 6 in. deep, 2 ft. wide to begin with, increasing gradually in cross section to 4 ft. or 4½ ft. in width as the tree grows. It is useless applying manure near the stem of the tree and it becomes more useless every year the tree grows.

'Manuring is probably best done in October and early November after the roots have been opened out and aerated. As an alternative practice some growers advise the application of (i) at the beginning of the rains when the land is first ploughed and (ii) and (iii) in October when the second general clearing of the garden takes place.'

In the Philippines

P. J. Wester in his book, *The Mango* (Bulletin No. 18 of the Philippine Bureau of Agriculture) writes :

'The soil in the Philippines is in general sufficiently rich in all elements for the development of the trees. In fact, it seems to be well supplied in nitrogen and in consequence the trees develop top at the expense of fruit production. During the early development of the trees, artificial fertilizer is ordinarily an unnecessary expenditure in the Philippines but later when the trees come to bearing, to counteract the influence of a superabundance of nitrogen in the soil, it would seem reasonable that the judicious applications of a fertilizer containing potash and phosphoric acid would increase fruit production. These applications should be made from September 1 to about January 1 and not during the spring or summer months. The application of well decomposed stable manure to the young trees will hasten their development but when they become of fruiting age it is best to use it only on very poor soils.'

Wilson Popenoe in *Tropical and Subtropical Fruits* says : 'Recent experiments indicate that a liberal application of potash is extremely beneficial. A standard commercial fertilizer specially prepared in Florida for use of mango trees contains ammonia 5 to 6 per cent, phosphoric acid 7 to 9 per cent and potash 9 to 11 per cent. These elements are derived from ground bone, nitrate of soda, dried blood, dissolved bone black, and high grade potash soils.'

Woodrow recommends for India that young

trees be fertilized liberally with barnyard manure ; but he adds that as soon as they come into bearing, the application of manure must be stopped and leguminous crops planted between the rows.

P. J. Wester in the book already quoted says : ' Judging from the experience in Florida, a formula calling for 8 per cent phosphoric acid and from 3 to 4 per cent potash is likely to answer. Such a fertilizer can, to the best advantage, be made from 450 kilos superphosphate (17 per cent) and from 60 to 80 kilos high-grade sulphate of potash (50 per cent). About 2 kilos of this mixture should be applied twice a year and coincident with the ploughings at the beginning and close of the rainy season to a tree with a crown diameter of 5 metres, larger trees receiving proportionately larger amounts. Or 400 kilos bonemeal (20 per cent phosphoric acid, 5 per cent nitrogen) might be substituted for the superphosphate which would also give the mixture 2 per cent nitrogen. The fertilizer should be broadcast on the ground away from the trunk in a circle under and slightly outside the crown.'

Organic manure

P. H. Rolfs in *Bulletin No. 127 of the University of Florida* writes : ' The mango tree is as sensitive to the kind of fertilizer as is the citrus tree. During the early growth of the tree, and before it begins to produce a crop, organic ammonia such as dried blood or cottonseed meal may be used at times to advantage ; but this is easily overdone, and then frenching of the tree will occur, even in the nursery rows. A good and fairly safe fertilizer for nursery trees and newly set groves may be made of the following ingredients : sulphate of ammonia 125 lb., dried blood 200 lb., high-grade sulphate of potash 200 lb. and acid phosphate (14 per cent) 800 lb.

' The amount of this fertilizer to be used will have to be determined by the conditions ; but from 1 to 3 lb. per tree for the first year, with probably double the amount for the second year, would seem to be sufficient under ordinary conditions. The fertilizer should be scattered in a circle not less than 4 ft. in diameter and well worked into the soil. For bearing mango trees a good fertilizer may be made up from 250 lb. sulphate of ammonia, 300 lb. high-grade sulphate of potash, and 850 lb. (14 per cent) acid phosphate. Large bearing trees may be given from 10 to 40 lb. per year. One fourth may be applied about the first of October, one half about the middle of January, and the remainder about the first of March. The amounts should be varied according to the needs of the tree. A tree exhausted by a heavy crop should have an application of 1 to 5 lb. of sulphate of ammonia or nitrate of soda immediately after the crop has been taken off.

Remedy for dry periods

' During excessive dry periods, the ammonia of the soil available to the tree becomes too low for the health of the tree as shown by a loss of green colour. This may be partially remedied by an application of nitrate of soda or nitrate of potash at the rate of one to several pounds per tree according to the individual need. During some years a period of heavy rains occurs and the available ammonia is leached out of the soil. After such periods, the trees take on a yellowish and sickly look. This can be quickly remedied by an application of nitrate of soda.

' It frequently happens that mango trees, even with the best care and attention and with a reasonable amount of fertilizer, fail to respond and grow. Such trees are frequently helped materially by being given an application of stable manure. Stable manure used as a constant fertilizer will be found as unsatisfactory in the mango grove as in the citrus grove. It is not advisable to use any stable manure in groves that are making a reasonably good growth.'

W. T. Pope in *Bulletin No. 58 of the Hawaii Experiment Station* states : ' No systematic and careful experimenting with fertilizer for mangoes has been done in Hawaii. The station has from time to time fertilized the old mango orchard with well-rotted barnyard manure at the rate of about 10 tons per acre.'

J. E. Higgins, in *Bulletin No. 12 of the Hawaii Experiment Station* states : ' No systematic and careful experimenting with fertilizers for mangoes has been done in Hawaii. Experience in India has led to the use of

bones in the holes where mango trees are to be planted, and this has produced good results, the bone furnishing both phosphoric acid and nitrogen.'

Use of salt

Woodrow, in *Gardening in India*, states that in some of the very rainy districts it is customary to apply salt at the rate of about 10 lb. per tree several months before flowering should take place. The object of this seems to be to arrest the growth in order that the tree may mature fruit buds.

In the German journal *Der Tropenpflanzer*, 1938, there is an article '*Die Dungung im Obstbau Der Tropen Und Suptropen*' (Manuring in tropical and subtropical fruit culture). The following very short reference is included in it :

'Mango, etc., etc. For these sound experimental results are not forthcoming. There are, however, various findings among which are those of Jacob and Coyle who recommend the following for established plantations as annual dressings : 40 to 50 kg. nitrogen, 60 to 80 kg. phosphate and 100 to 150 kg. potash per hectare.'

In pounds per acre these figures mean 45 to 56 lb. of nitrogen per acre ; 67 to 112 lb. of phosphate per acre ; and 112 to 168 lb. of potash per acre.

ANIMAL HUSBANDRY IN ANCIENT INDIA—III

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IN *Agni Purana* we find the king being enjoined to preserve the breed of cattle in the country. The *Arthasastra* mentions a Government officer called the Superintendent of Cattle, another called the Superintendent of Horses, whose exclusive duties were to supervise livestock in the country, keep a census of them and see that they were properly bred and reared. The superintendent of cattle classified them as calves, steers, tamable ones, draught oxen, bulls that were to be trained to the yoke, bulls kept for breeding purposes, cattle fit for slaughter, buffaloes and draught buffaloes; female calves, heifers, pregnant cows, milch kine, barren cattle, either cows or buffaloes, etc. Under the fear of cattle-lifting enemies, owners sometimes kept their animals under the immediate care of the Superintendent, giving the state one-tenth of the dairy produce.

Castration of scrub animals was permitted, but was allowed to be done only on certain days and months of the year. According to the edicts of the Emperor Asoka, a bull, a goat, or a ram should not be castrated on the 8th, 10th, 13th and 15th day of each fortnight, nor on the *punarvasu* day, on any festival day, and during every fourth month of the year.

Dedication of bulls

Brahminical bulls were inviolable and were objects of special attention and care on certain festival occasions. Dedication of bulls for breeding purposes was a great ceremony and had to be performed under certain well-laid out rules and regulations. On any auspicious day which is generally the full-moon day of the month of *Karthigai* or *Asvina*, the bull was set at liberty. It was at first marked, preferably on the right flank, with a discus and on the left flank with a trident, then bathed, adorned with flowers, turmeric, etc. Certain hymns were then chanted, and the bull was brought before four young cows which were also well bathed and decorated. Into the ears of the cow was uttered the *mantra*: 'This young bull I give you as your husband'; and in the ears of the bull was uttered: 'The father of calves.' Selection and necessary qualifications of a bull for such dedication are interesting. In the *Vishnu Purana*[1] it is said that the bull should be the offspring of a milch cow with young ones living. It should not be deficient in any limb, and it should be capable of protecting the herd. *Matsya Purana*[2] ordains that the bull should have elevated shoulders and hump, a soft and straight tail, tender cheeks, broad back, shining eyes, sharp horns, and big tuft of hair in the tail. It must be well built, with a roar like thunder, high in stature, and walking like an infuriated elephant. In the *Mahabharata*[3] cattle-census and pedigree registers are described All of them show that the Aryans were very particular about the general conformation and physical fitness of the breeding bulls. The *Arthasastra* mentions that every herd of 10 head of cows or buffaloes should include four bulls. Particulars of the time of service are well described in *Sukadam Nask* of Dinkard.[4]

Livestock feeding

The manner in which the stock were fed was most important because the breeds depended primarily upon the feed. In the *Rig Veda*[5] barley and corn have been advocated; while *Agni Purana*[6] described the marvellous thriving of cattle on a food consisting of *Phaseolus radiatus*, sesame, wheat, clarified

[1] Chapter LXXXIV.
[2] Chapter CCVII.
[3] Ghosa gatra parva.
[4] Book III.
[5] Book X 27-8.
[6] Chapter CCXC-iii-32.

butter, cream of milk and salt. The *Arthasastra* is even more elaborate and detailed in this respect. It is ordained therein that all cattle should be supplied with plenty of fodder and water, and that draught oxen and milch cows should be provided with subsistence in proportion to the nature and duration of the work allotted to the oxen and the quality and the quantity of milk-yield of the cows. Elaborate prescriptions regarding the nature and the amount of ration that a bull, a cow, or a buffalo should be given, are described thereunder thus:

'For bulls equal to horses in speed and loading capacity, half a *bhara* (maund) of meadow grass, twice the above of ordinary grass, one *tula* (100 *palas*) of oil-cake, 10 *adhakas* of bran, 5 *palas* of salt, one *kudumba* of oil for rubbing over the nose, one *prastha* of drink, one *tula* of fruit pulp, one *adhaka* of curd, one *drona* of barley or cooked black gram, one *drona* of milk, half an *adhaka* of *sura* (liquor), one *prastha* of oil or ghee, ten *palas* of sugar and one *pala* of the fruit of *sringibera*, are recommended. Three-fourths of all the items above will form the food for mules, cows, and asses; and twice the quantity for buffaloes and camels.'

Dairy farming

Every village had its own pasture lands and forest lands. Common rights in pasture and forestry were important and recognized by the state. In the *Arthasastra*[1] the king has been directed to set apart pasture lands in uncultivated tracts. In the *Manu Samhita*, it is enjoined that on all sides of a village a space about 100 *dhanus* in extent should be reserved for pasture, and thrice that space round a town. In all royal grants of villages, special provisions were always made for them. The cattle were allowed to graze freely in these pasture lands, and forest lands supplied fuel to the people and thus saved much of the cowdung nowadays used as fuel with a consequent loss of the available manure for agricultural purposes.

There were professional herdsmen who took the cattle for grazing early in the morning and brought them back in the evening. The ancient Indian lawgivers have given due attention to these herdsmen. In olden days, as now, tinkling bells were attached to cattle so that the whereabouts of those straying in the forests could be easily known. In the *Arthasastra*, it is suggested that the cattle should be grouped in herds of ten of similar colour while grazing. The cowherds were expected to have a full knowledge of all the common ailments of cattle and their remedies. They were considered wholly responsible for the safety of the cattle, while on pasture lands, and any loss due to their negligence should be recouped by them. In cases of death of an animal from natural causes, the cowherd should surrender to the owner the skin of the dead animal, its fat, bile, marrow, teeth, hoofs, horns and bones. In return for such responsible duties done by these herdsmen, Manu[1] ordains that 'for tending 100 cows, a heifer shall be given to the herdsman as wages every year; for tending 200 cows, a milch cow; and he shall be allowed to milk all the cows for himself once every eight days.'

Fodder for cattle

Cultivated lands were available for grazing after the crops had been harvested. The weeds on cultivated lands, the plants growing up from the seeds falling both before and during the harvest, the stumps of the crops, and grass on the field borders and along water-channels were made available for the cattle. The cultivation of fodder crops and their conversion into silage was a process known to the earliest Indians, as suggested by the word *sujavas* which occurs in the *Rig Veda*.[2]

In the early Rig Vedic period, milch kines were milked thrice a day, morning, noon and evening. It was usually the duty of the grown-up daughters of the household to milk the cows. This is evident from the fact that the Sanskrit name for daughter, viz. *duhitri*, literally means the milker. In a later period, however, definite rules were laid down restricting the time of milking to once or twice a day, according to the season.

One *drona* of cow's milk was known to

[1] Book II Chapter 2.

[1] VIII-31.
[2] Book VI-28-7 and Book VII-99-3.

yield one *prastha* of butter, and that of buffalo milk, one-seventh *prastha* more. In the *Arthasastra*, it is said that the increase in the yield of milk and butter depends upon the nature of the soil, the quality and the quantity of fodder and water allowed. In the *Agni Purana*, it is advocated that to increase the supply of milk the cow should be given daily a few morsels composed of several sticks of *Asvagandha* (*Physalis Flexosa*) and sesame.

It is thus evident that in ancient India there were fine breeds of cattle ; milch kine were more productive and plough cattle more efficient than they are generally in our time.

Causes of deterioration

That there has now been a general and all-round deterioration in the cattle breeds of India requires no elaborate proof. The causes are not far to seek. Medieval India had to pass through a series of foreign invasions and internecine quarrels and wars, and attention to the improvement of agriculture and animal welfare receded to the background. Decrease in the grazing area and the ignorance and poverty of the ryots are also two of the most important factors that have contributed to the present deteriorated condition of cattle.

In ancient days, cattle breeding was one of the professions. While describing the former condition of cattle in India, the Indian gazetteers make reference to certain herdsmen as expert cattle-breeders who were well conversant with the ways and means of skilfully tending cattle. Even up to recent times, these herdsmen existed in several parts of India, and it is to them that the report of the Royal Commission on Agriculture (1928) attributes the fine breeds of cattle that are still to be found in many parts of the Punjab, Sind, Gujarat, Kathiawar, Mysore, Ongole, and Kangayam.

What the Scientists are doing

COTTON STEM WEEVIL

IN parts of Madras, where Cambodia cotton is grown over large areas, healthy plants wither away all of a sudden due to the damage caused by the cotton stem weevil. In seasons of severe incidence, the loss by death of plants may be as high as 25 per cent. To overcome the ravages caused by this pest, the Indian Central Cotton Committee is financing a scheme the object of which is to devise effective control measures based on the study of the life-history, habits and bionomics of the insect, the nature of the plant's resistance to weevil infestation and the efficacy of the biological methods in checking the spread of the pest.

Problem of control

The association of the pest and the host has been found to commence from the time the egg is laid by the adult insect in a small cavity made for the purpose in the collar region of the stem just above the ground level. The most critical period in the relationship between the host and the pest is when the insect cuts out a ring of the functioning tissue around the woody region during its travels inside the stem in search of food. The injury thus caused generally results in the death of the plant. After a period of active burrowing inside the stem, the larva pupates in a chamber excavated in the core of the stem and finally emerges as an adult insect through a previously made passage. The insect borer thus completes its life-history, from the egg to the adult stage, inside the stem and thus presents one of the most difficult problems in the field of insect control.

The attacked plants which survive to the end of the season escape death either by the exudation and formation in the larval gallery of wound gum which entombs the larva or by proliferation of tissues and development of one or more galls at the attacked part of the stem which prevents their lodging or by both these means.

The weevil appears to attack all cottons—exotic and indigenous—and no variety, cultivated or wild, has so far been found to be immune to its infestation. Nadam cotton amongst the Asiatic and Bourbon and three Brazilian varieties, viz. Quebradinho, Verdao and Moco, amongst the New World cottons have, however, proved to be highly resistant. The nature of resistance in the case of Nadam and Bourbon cottons is mainly by rapid proliferation of tissues, while in the three Brazilian varieties the resistance is due to ready exudation of gum into the larval gallery.

It has been found that the weevil passes through three generations during the cotton season—September to March—at Coimbatore. In addition to cotton, it infests a large number of alternative host plants such as *bhendi*, *hollyhock* and several wild plants and weeds. The presence of a large number of such host plants near the cotton areas seems to preclude the effective enforcement of a close period to starve out the pest.

Attempts to control the stem weevil by means of its natural enemies have not so far yielded any successful results; while the *pempheres* larvae are parasitized by 15 or 16 different parasites, the maximum percentage of total parasitism is very low, ranging from 0·2 to 5·2 per cent.

Promising hybrids

Gum formation appears to occur earlier and quicker in the Brazilian varieties than in Cambodia on account of changes in the water soluble polysaccharides of the plants, but the relationship between resistance and the amount of polysaccharides present has not been found to be significant.

The local Cambodia strain, Co.2, has been found to be highly susceptible to attack, and attempts are being made to evolve a strain which is resistant. Notwithstanding their high degree of resistance, Brazilian varieties referred to above cannot be introduced in the tract, as all of them are perennial, late maturing, poor ginners, susceptible to jassids and defective as regards boll opening. Amongst

the different hybrid populations under trial, the progenies of Moco × Co.2 cross have been found to be most promising in respect of resistance. As a result of comparison of the progenies of Moco × Co.2, two cultures, 7176 and 7178, which have shown low proportion of mortality and adult emergence, have been isolated. In order to introduce vigour and early maturity, they have been crossed with the newly evolved strains from Co.2 × Uganda crosses. Trials are now under way to isolate resistant strains which are at the same time early maturing and superior to the local in economic characters. The criterion of selection is nil mortality and nil adult emergence; in other words, a plant which quickly floods all the burrows with gum and entombs the larvae. Special precautions are taken to create uniform incidence of the pest at all points of the field and to increase the intensity of infestation by spreading infested stems containing fully grown larvae and pupae, so that the resistant types may be spotted easily.

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GROUNDNUT AS HUMAN FOOD

GROUNDNUT (*Arachis hypogoea Linn*) is really a leguminous plant, although in their chemical composition groundnuts resemble nuts such as cashew, almond and walnut more closely than they resemble pulses. The plant is a native of Brazil, from whence it spread to Africa and Asia. It has been cultivated in the tropics and sub-tropics for several centuries, and in India groundnut is an important crop. It is grown chiefly in Madras, but Bombay and the Central Provinces are also important centres of production. In normal times groundnut oil and cake are exported in large quantities to the United Kingdom and the continent of Europe. As a result of the war, exports from the Madras province dropped from 760,000 tons in 1938-39 to 282,000 tons in 1940-41.

The reduction of the export trade has produced a disposal problem. One method of disposal would be its wider use as human food and this raises the question of its nutritive value. Per 100 grammes, it contains about 25 to 33 grammes of protein, 40 to 50 grammes of fat and 10 to 20 grammes of carbohydrate. It is rich in phosphorus, but not in calcium. As regards its vitamin content, it contains some of the B vitamins, notably B_1 and an important member of the B_2 group, nicotinic acid, in fair amounts, but no vitamin A. Groundnut oil, like most vegetable oils, is devoid of this valuable constituent. Vanaspati or vegetable ghee, which is usually made from groundnut oil, does not contain fat soluble vitamins A and D.

Experiments with groundnut

In the Coonoor Laboratories a long series of experiments has been carried out on the value of various foods in 'supplementing' poor rice diets. Rats are given a diet which resembles in composition poor rice diets eaten by human beings. Different foods are added to this basal diet and their effect on the development of the rats observed. This method of testing provides a good idea of their nutritive value under Indian conditions—in fact it is in some ways a better index than detailed chemical analysis. If milk is added to the rice diet, the result is a striking increase in the growth rate and an improvement in the general condition of the animals. Groundnut, however, when given in amounts equivalent to 1 to 2 oz. daily in a human diet, does *not* produce any striking supplementary effect. The conclusion is that groundnut, although it is rich in certain food factors, does not contain enough of the constituents which are most needed by the poor rice-eater to make good the defects of his diet. Milk, on the other hand, contains these in the correct proportions. It is possible that the relatively low calcium content of groundnut is to some extent responsible for its failure as a supplement and its deficiency in certain vitamins in the B_2 group may also be concerned. Experiments on this subject are proceeding.

Suppose half to one ounce of groundnut were distributed daily to poor children in schools. It is not to be expected that such a supplement would be as effective in improving their state of nutrition as a glass of milk. On the other hand, groundnut, taken in small quantities, is perfectly good food.

Its high fat content makes it a concentrated food, with a high caloric yield per unit of weight. Since many poor school children are *under-* as well as *mal*-nourished, any supplement which increased their total food intake would be of value. In normal times peanuts sold very cheaply in small paper bags are very popular among poor children in London.

Groundnuts as such have never been used as a *staple* human food anywhere in the world. Consumed in large quantities they tend to be nauseating, probably because of their high fat content. Their main use has always been as a source of oil, the 'cake' which remains after the extraction of oil being employed as cattle food and manure. It is said that groundnut cake is used as human food in Spain. In U. S. A. so called 'peanut butter' has been fairly widely consumed, and in that country roasted peanuts are very popular. The inclusion of groundnut flour in small quantities in wheaten biscuits has been suggested.

The idea that groundnuts could be used in India as an important article of diet, replacing equivalent quantities of cereals such as rice, may be dismissed. They could, however, be consumed in somewhat greater quantities as an *addition* to ordinary diets, either in the form of roasted nuts or as a sweetmeat with jaggery. Even a slight increase in consumption would help to dispose of surplus stocks. In the present circumstances it is unfortunate that they cannot be strongly recommended by the nutrition worker as an exceptionally valuable food, but there is no reason why their use as human food should not be extended. *—Note issued by the Nutrition Research Laboratories, I. R. F. A., Coonoor.*

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q: Can you advise me on the manurial requirements of mangoes and mention the literature available on the subject?

A: See the article 'Manuring of Mango Trees: The Present Position' by S. C. Roy on pp. 575-8.

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Q : Many people use the silver spoon method of distinguishing between edible mushrooms and toadstools, i.e. they cook the silver spoon with the mushrooms and if the spoon goes black they consider the mushrooms are not safe to eat. But there may be other and better methods of ascertaining this and I shall be grateful for information.

A: There are no special tests to distinguish between edible and poisonous mushrooms. As far as we know there are not more than a dozen poisonous kinds that must be avoided at all cost whereas the edible species number more than a hundred. In order to avoid poisoning by mushrooms the best way is to know the killers first. Many writers give general rules as to the kinds of mushrooms to avoid, such as those with a volva or a sack, those with pink spores, those growing in woods, etc. These rules are of some value, but the one golden rule is not to eat a fungus until its identity is certain. Therefore any fungus before use should be sent to a specialist for determination.

Among the poisonous kinds, the deadly Amanitas and false morels take the lead. All forms that have a powerful peppery or nauseous taste should be avoided. Those having milky juice should be avoided. Some characters lead us to recognize the Amanita groups; when young they are egg-shaped and completely enclosed in a veil which ruptures as the cap pushes upwards and remains attached at or near the bulbous base as a cup with fragments or warts, appropriately known as the 'dead cup'. In order to recognize this most important marking, it is necessary to dig up Amanita with care as the cup may be concealed in the ground. Secondly, the Amanitas have a ring on the stem above the cup, just below the cap. The Amanitas grow on the ground, never on trees. Lastly, many of the poisonous Amanitas are distinguished from edible mushrooms by having white gills, and if the caps are laid on a piece of paper when mature, they all shed white spores.

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Q: I am keeping seed potatoes in a cold-storage plant at 38-40°F. The cultivators like to have their seed potatoes in a sprouting condition. Would you advise increasing the temperature for a few days before taking the potatoes out of the store?

A: It has been found in America that it is advantageous to raise the temperature to about 70°F (21°C) for about twelve days prior to planting. Obviously, however, it must depend on the condition of the tubers at that time. Some early varieties, such as Gola, have a short period of dormancy, after which they may sprout quite rapidly even at 40°F. If such tubers have had the sprouts rubbed off once or twice during storage at the low temperature, it would be unwise to raise the temperature to 70°F for so long a period as twelve days. If the potatoes are not sprouting and are not rotting appreciably, certainly increase the temperature somewhat.

Q : For the last two years we have had a severe attack of smut on Co. 213 cane. Attacked plants show a very quick growth and after forming a few thin internodes a black head appears full of spores. Will you please suggest practical remedial measures and enlighten us about the above disease ?

A : The smut disease of sugarcane in which a long black whip-like appendage emerges from the centre of the cane-spindle is a serious disease of susceptible cane varieties when adequate attention is not paid to maintaining a stock of healthy cane-crop which is to be used for seed purposes the next season. The black whip is the storehouse of millions of smut spores which are particularly suited for dissemination. From a few primary cases, which occur during May and June the spores are blown about to the neighbouring canes and these infect the 'eyes' which may sprout during the growing season, and show the smut whip or the infection may remain latent and when setts with such 'eyes' are planted give rise to smutted canes. The accumulative effect, i.e. the disease incidence increasing in an affected locality if proper care is not taken to check its spread, is quite a common phenomenon and seems to have been experienced by yourself in your cane plantation.

The disease, though a fairly serious one, can be kept well under control by such simple practices as careful seed-selection and roguing off the smut cases, *as soon as they appear*, throughout the growing season. If properly carried out for three successive seasons, you may confidently hope to get rid of the disease from your cane plant almost completely. Our experience fully warrants such success. Care should be taken that, although only one or two shoots may be actually showing the whip, the entire clump should be dug out and burnt. It is useless to cut off only the affected shoots. This merely stimulates the production of numerous small smutted tillers, each with a spore whip, to spread further infection. Another precaution that is equally necessary is not to allow the spores to fall away from the whip on the soil, through inevitable shaking of the stools while digging out the affected clumps. The best and the simplest way to effect this most necessary caution is to have a small bag of closely woven material, the whips should be gently removed from the affected clump and placed inside the bag, the mouth of the bag closed with string and then the clump should be dug out, removed from the field and destroyed. The bags containing the smut whips should be immersed in boiling hot water for half an hour. The bags are quite sterile after this process and can be used for whip collection at the next round. Unless this shedding of the spores is avoided the desired object will not be achieved.

These rounds for such 'smut-roguing' should be made as frequently as possible, particularly during the months of May, June and September, when the two main flushes of whips usually appear. It should be done at least once a week.

What's doing in All-India

BENGAL

By Nirmal Deb, L.Ag.

Propaganda Officer, Department of Agriculture, Bengal

AGRICULTURAL demonstration and propaganda in the province have been making headway in recent years. For work under this category the province is divided into three circles (viz. Eastern, Western and Northern), each in charge of a Deputy Director of Agriculture, assisted by a Superintendent of Agriculture. Each of the administrative districts in a circle is in direct charge of a District Agricultural Officer with several agricultural demonstrators under him. Besides controlling the demonstration work in their circles, the Deputy Directors control the district agricultural farms, in charge of the District Agricultural Officers. There are now 21 such farms in the province besides five run on the *barga* system. These farms serve three purposes, viz. (i) they are supplementary experimental stations of the experts where improved seeds evolved at the Central Experimental Station at Dacca are tried with a view to testing their superiority under the local soil and climatic conditions; (ii) they are seed-multiplication centres where the improved seeds in demand in a district are raised to meet the local demand; and (iii) they are demonstration farms where the cultivation is done on improved lines for the education of the cultivators and also for the demonstration of the economic aspects of improved cultivation.

How demonstration is organized

The demonstration work is now being carried out mainly through the schemes of union board farms and demonstration centres started in 1938-39. A union board farm is started in a compact block of about 15 *bighas* (5 acres) belonging to a private enthusiastic agriculturist with an assurance from him of continuing it permanently after the Department gives it up after three years. Only the seeds recommended by the Department are grown on these farms, and such useful necessaries of improved farming are adopted as are within easy reach of the cultivators, such as preparation of artificial farmyard manure from all sorts of vegetative refuse, manufacture of water-hyacinth compost, preparation of silage, conservation of cattle dung in shedded pits and storing of seeds in approved *golas*. The union board farms are thus serving the double purpose of seed multiplication and demonstration and forming an effective link between the Department and the cultivators at large. At the demonstration centres improved seeds, manures, etc. are distributed among many cultivators in a locality, the idea being to bring as many cultivators as possible in touch with the activities of the Department and thereby promote quick dissemination of the improved seeds and methods. These union board farms and demonstration centres are being run under the direct supervision of the agricultural demonstrators, each of whom has one union board farm and three demonstration centres within a working circuit of five miles from his headquarters. It can now be definitely stated that these schemes have proved to be of immense benefit to the cultivators by helping them to get a better return from their land. This is amply borne out by the fact that all the departmental crops introduced under these schemes have been yielding, without exception, 3 to 5 md. more per acre than the local, and the artificial farmyard manure and water-hyacinth compost which are catching on have gone a long way in making up for the lack of cowdung which is virtually the only manure they generally apply. Most of the demonstration crops of sugarcane last year yielded over 1,100 md.

per acre while the general yield of the cultivators' cane hardly exceeded 400 md. There are now 193 such union board farms and 561 demonstration centres working in the province against 190 and 546 respectively during 1940-41.

Effect of propaganda

The total number of cultivators known to have participated in the aforesaid schemes last year was 14,714 besides 479 who took part in the special demonstration of Patnai No. 23 *aman* paddy in eight districts. In spite of the positively adverse weather conditions prevailing last year, 21,855 md. of the departmental *aus* and 54,501 md. of *aman* paddies were raised on the union board farms and demonstration centres and over a half of these quantities was utilized for seed purposes. This alone indicates to what extent the demonstration schemes have contributed to the automatic expansion of the improved crops in the province. The most remarkable result achieved in the demonstration work has been the introduction of English vegetables in the rural areas. These vegetables could hardly be seen in the villages five years back, but now after three years of successful demonstration schemes they can be said to have been established among the cultivators and even in the backward tract of the Duars. Quite good specimens of these vegetables produced by the cultivators were exhibited in the agricultural, industrial and health exhibitions held in the districts and sub-divisions last season. Another outstanding achievement in demonstration work has been the preparation of artificial farmyard manure by the cultivators who were indifferent to it a few years back. The total amount of compost prepared by the cultivators under the demonstration schemes last year was 147,240 md.

In order to stimulate the proper storing of the departmental seeds raised by private growers and their wider distribution, subsidies to private seed stores in the form of a premium on every maund of seed supplied are given. The conditions imposed for payment of this premium are: (i) the seeds must be of departmental origin, (ii) they must be reasonably pure and of good germination, and (iii) they must be sold for seed purposes only. This scheme has proved to be very successful and has given an incentive to the farmers and *jotedars* to grow the departmental seeds and store the crop carefully for supply as seed.

Free literature

A bi-monthly agricultural journal called *Krishi-Katha* is being published by the Department and distributed free to the people engaged in agriculture or interested in the agricultural movement. The journal is in simple and non-technical Bengali and contains matters of varied interest to the agriculturists. It is edited by the Propaganda Officer of the Department and is now in its third year.

UNITED PROVINCES

By C. Maya Das, M.A., B.Sc. (Edin.), I.A.S.
Director of Agriculture, United Provinces, Lucknow

A FIVE years' scheme for the cultivation of Virginia tobacco in Bundelkhand is being financed by the provincial Government. It was taken in hand in order to introduce a new cash crop for Bundelkhand, and also to meet the increased demand for cigarette tobacco on account of the war. It provides for the cultivation and curing of cigarette tobacco at the Government Farm, Bharari, near Jhansi. It will run at a total cost of Rs. 2,45,498 of which Rs. 81,103 is recurring and Rs. 1,64,395 is non-recurring. About 300 acres have been put under tobacco at the Bharari Farm and demonstrations on cultivators' fields have been laid out in the neighbourhood of Jhansi in order to popularize

the growing of Virginia tobacco. Tobacco-curing barns have been constructed at the Bharari Farm, and the tobacco cured in them will be purchased by the Indian Leaf Tobacco Co., Ltd.

Mixed farming scheme

In order to demonstrate the advantages of mixed farming, a five years' scheme has been sanctioned by the Imperial Council of Agricultural Research which will bear half the cost, the other half being borne by the provincial Government. In the western parts of the United Provinces where the holdings are comparatively large, the farming unit will be of 10 to 12 acres, while in the eastern districts where the holdings are smaller, they will be of 7 to 8 acres each. A block will consist of two mixed farming units and four other units farmed according to the ordinary practice. The cropping programme of the mixed farming units will be in conformity with the conditions in the locality, and will aim at supplying the requisite fodder for one pair of bullocks, two milch animals, their calves and an equal number of young stock. The milk produced will be sold in the market and will bring in cash returns to the cultivators, while the keeping of more animals on the land will help to increase the supply of manure. The mixed farming units will be located on the holdings of selected cultivators who will be given a *takkavi* advance for the purchase and a cash subsidy for the maintenance of livestock and for better cultivation. The staff employed for running the scheme is receiving practical training in mixed farming at the Bichpuri Farm near Agra, where mixed farming has been practised successfully for some years. It is hoped that the scheme will fulfil the object of raising the cultivators' cash returns while maintaining the fertility of the soil.

Groundnut cake as manure

The Agricultural and Cane Development Departments together prepared and supplied 160,000 maunds of fertilizer mixture for the sugarcane crop to the cultivators throughout the province. The mixture consisted of decorticated groundnut cake and sulphate of ammonia. Although groundnut cake is a valuable food for cattle, it is recommended for manurial purposes because it is used very little as a cattle feed at present and is the cheapest cake on the basis of unit nitrogen value.

Entomological work in the United Provinces is conducted chiefly at Muzaffarnagar, Chaubatia and Cawnpore. At Muzaffarnagar, a study of pyrilla incidence has indicated that there is greater concentration of this pest in ratoon than in plant cane. Another observation has shown that the top borer, stem borer and pyrilla infestation is heavy in early harvested sugarcane of the varieties Co. 312 and Co. 421. In view of the locust swarms that visited parts of this province last winter, special vigilance has had to be maintained to detect the presence of locusts in the province and also to keep watch over their movements in areas adjoining the United Provinces. At present the danger of a locust invasion appears remote.

In order to verify the results of the experiments conducted on the sugarcane crop at the research stations, and to acquaint the cane growers with the results thus obtained, an important step has been taken this year by starting a scheme of zonal trials at various centres all over the province. A few simple experiments have been laid out, mostly at factory farms at about 18 centres, for the current season. They comprise varietal and manurial tests. Detailed printed instructions have been issued to the factories regarding the conduct of the experiments in order to ensure uniformity of procedure. The staff engaged in the work has also been given practical instruction regarding the carrying out of the tests.

Promising sugarcane

The domestication and selection of sugarcane varieties forms a very important function of the Shahjahanpur research station and this type of work is being carried out simultaneously at the research stations at Muzaffarnagar and Gorakhpur. In the final standard yield trials of cane varieties, Cos. 186 and 545 from Shahjahanpur, Co. 453 from Muzaffarnagar and Co. 26 from Gorakhpur were found to be very promising, both in regard to yield and sucrose, and were picked out for further

locality tests on departmental farms, factory farms and big cane-growers' farms, under the scheme of parallel yield or zonal trials of new cane varieties.

The Economic Botanist in charge of oilseeds tested about 200 strains of linseed against established departmental types and cultivator's varieties, in replicated trials of quasi-factorial design. Some of these appear to be promising. Selection of improved linseed strains of types C 1150, C 1193, C 1206, C 477 and C 483 was continued. Samples of local mustard varieties from the different parts of the province were collected and studied with a view to determining their performance. Among the improved mustard types, RT 11, an early variety, has given consistently good results and is attracting the attention of growers.

Popular cattle fair

Most of the cattle fairs in these provinces have generally a religious or quasi-religious basis, and people from far and near flock to them. The Deva fair in the Bara-banki district is an outstanding example of such a fair. Over 60 years ago Haji Saiyed Waris Ali Shah, the celebrated saint of Deva, inaugurated the Deva fair in commemoration of the death of his father. In 1905 the saint died and his followers built him a worthy tomb. Every year in *Kartik*, starting from *Karwa chauth*, the fourth day of the month, thousands of devotees make pilgrimage to this tomb. The Deva fair, which was once a small bazar, is now a well-attended exhibition and animal fair which is held on the original site known as Shah Raushan. The Agricultural and Veterinary Departments have contributed to the success of the fair by their active encouragement and participation. The sale of livestock is the chief source of income at the fair. In 1940 over 16,000 animals were brought for sale and the income realized was about Rs. 15,000. A large majority of the livestock came from the Punjab. They are mostly young draught cattle with a fair proportion of good Murrah buffaloes.

The Maragshri fair, also called the Soron fair, is held annually at Soron in the Etah district in the month of December. It is a religious fair of the Hindus and a large concourse attends it from all over the province. The Agricultural Department held a cattle show along with the fair. There was a brisk sale of cattle.

THE PUNJAB

By Malik Amanat Khan, B.Sc. (Edin.)
Associate Professor of Agriculture, Punjab Agricultural College, Lyallpur

As a result of the temperature being abnormally high and the weather being dry in April and May the *rabi* crops matured considerably earlier than usual. The monsoon also set in early and the first showers of rain were received in the first half of June. These early showers benefited to a great extent all the standing crops and enabled the zemindars to open up their fallow fields. In the *barani* (rain-fed) areas, early *kharif* crops were also sown.

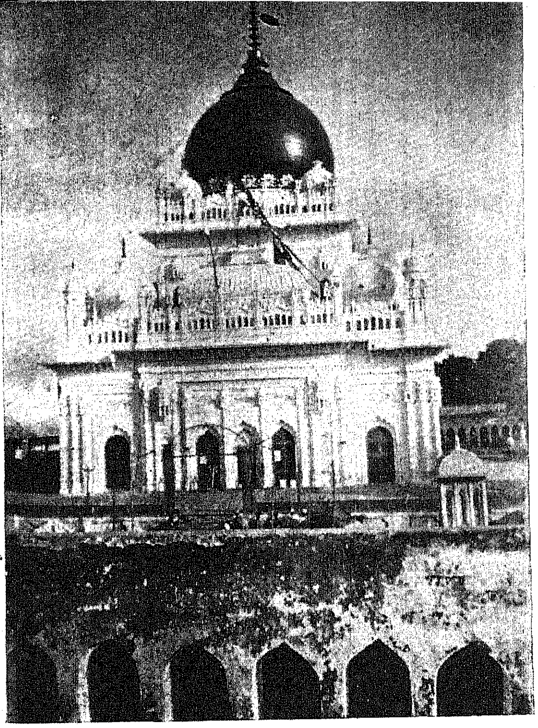
Crops

Wheat.—As has already been reported, persistent drought in the *barani* areas, and late sowings in parts of the canal colonies caused by canal closures resulted in giving the crop a poor start. Later on in March and April, the season was unusually hot, which hastened the maturity of the wheat crop all over the province by at least 10 days. This resulted not only in the reduction of yield but also caused considerable shrivelling of grain, particularly in the late ripening varieties.

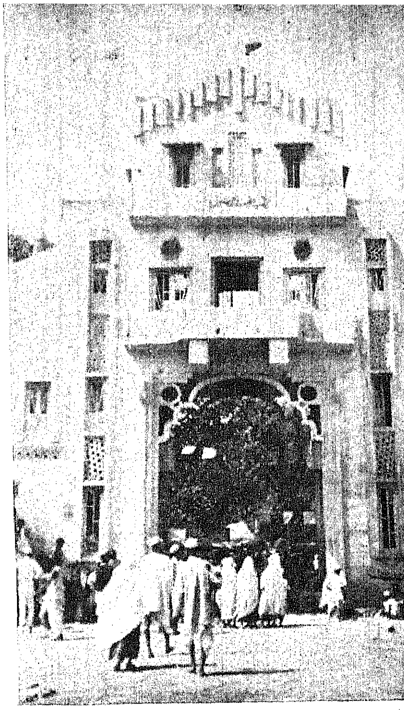
Sugarcane.—Sowings were finished in time. The condition of the crop appears to be normal so far.

Cotton.—Cotton was sown in time. Germination is reported to be satisfactory. Rains

DEVA FAIR



Tomb of the celebrated saint, Haji Syed Waris Ali Shah, Deva, U.P.



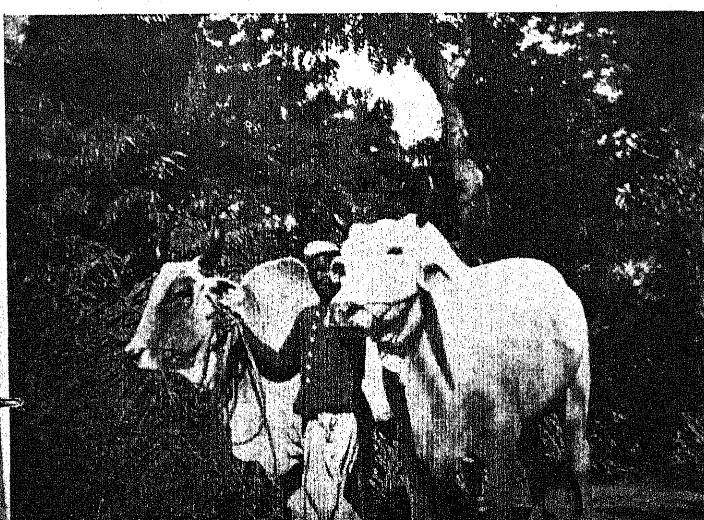
Main gateway o
exhibition at Deva
by Raja Ejaz Rasul
Sahib, Taluqdar of J
girabad Estate in 19

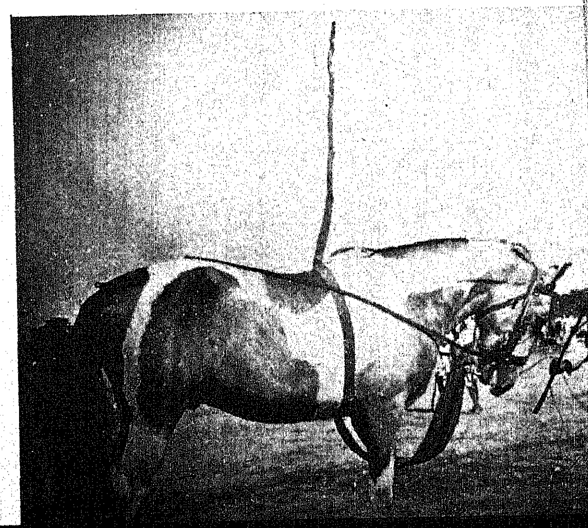
PLATE 152]

Murrah buffalo with calf, a prizewinner, at the Deva fair

Below : A pair of good draught cattle from the Punjab at the Deva fair

Below : Prize
(pedigree unknown
Kathiawari strain
Deva fair





received in June adversely affected the late-sown crop which had to be resown at some places.

Pohli *week*

By far the most outstanding event was the organization of the *Pohli* (*Carthamus oxyœantha* Bieb) week in May. The harm done to the cultivators by this pernicious weed is well known throughout those localities where it abounds in wheat fields.

Wheat fields in certain localities are so seriously infested with it that harvesting of the crop presents considerable difficulties. The weed is spread by means of its seed which is blown about by the wind or carried in water, and the aim of the *Pohli* week is the destruction of the weed before it reaches the seed stage.

In some districts in the Punjab the same week is observed as *Pohli* week throughout the whole district, whilst in other districts different tahsils observe different weeks depending upon the season and the number of officials available for organizing and controlling the work. On the dates fixed for these weeks the village officials (lambardars, school teachers and patwaris) organize parties and induce the zemindars to eradicate all *pohli* plants standing in their fields. Halqádars, circle officers, tahsildars and gazetted officers placed on *pohli* destruction tour freely and extensively and persuade people to clean their villages of this troublesome weed. *Shamláts* and other common lands are treated mostly by the village schoolboys during the early hours of the morning.

A special feature of the campaign in the Lyallpur district this year was that the students of the vernacular and the teachers training classes of the Punjab Agricultural College, Lyallpur were divided into groups and each group was allotted a number of villages for *pohli* destruction. The total area in which the students carried out these operations was about 30 square miles and from all accounts received it was a very good beginning.

New wheats for barani *areas*

Till quite recently the cultivators in the *barani* areas had a grouse against the Agricultural Department, for they felt that the improvements effected so far mainly benefited the canal-irrigated tract.

That grievance has now been removed. As a result of important research by the Cerealist and his staff at Lyallpur and elsewhere, there are now available improved varieties of wheat suitable for *barani* conditions. A couple of years ago C 409 was proved to be a better yielder, under *barani* conditions of the Rawalpindi Division, than any other wheat recommended under those conditions so far. Some new crosses, however, that later became available for small-scale trials have given comparatively better returns than C 409. In 1940-41, C 217 and C 219 were under extensive trials against C 409 on zemindará lands in the Rawalpindi Circle, and everywhere these new crosses have done better than C 409. Of these, from the data so far available, C 217 appears to be the better of the two, and consequently the best type of wheat for *barani* areas of the Rawalpindi Division.

Milling and Baking Laboratory

Studies carried out so far in the Milling and Baking Laboratory at Lyallpur have shown that environment has a considerable influence on the milling and baking qualities of wheat. The same type of wheat grown under different environmental conditions shows varying milling and baking behaviour. It has also been observed that samples of a type of wheat obtained from different fields with different yielding capacities, but from the same locality, differ appreciably in their milling and baking performance; the sample obtained from a field giving a lower yield is generally superior in baking, but inferior in milling quality. This finding demonstrates that beyond a certain limit, both quality and quantity cannot be combined and carried together and that beyond that limit improvement in one is likely to result in a deterioration in the other.

Wheat trials

Six Imperial Pusa wheats (I. P. 12, 80—5 and 165 beardless, and I. P. 114, 120 and 125 bearded) were given by the Imperial Economic

Botanist for trial against Punjab wheat (C 518). These trials were carried out for five years on rich land, and for two years on comparatively light land. In the rich land the rotation was wheat-cotton-sugarcane, both cotton and sugarcane being manured with farmyard manure at 10 and 15 tons per acre respectively. In light land the rotation was wheat-*toria*-cotton.

The sowings in all these trials were done during the first week of November. As the tillering capacity of the Imperial Pusa wheats is comparatively lower under Lyallpur conditions, a higher seed rate of one maund per acre in the case of these varieties was used, against 32 seers in the case of Punjab wheat, C 518.

The results of the trials are given below:

Rich land. Average of 5 years (1936-37 to 1940-41).

Variety	Yield in maunds per acre	
	Grain	*Straw*
I. P. 165	38·52	83·63
Pb. C 518	37·52	96·20
I. P. 125	36·83	91·35
I. P. 80-5	35·48	91·56
I. P. 114	31·99	94·49
I. P. 12	29·50	88·87
I. P. 120	28·32	100·67

In 1936-37 there was 100 per cent lodging in all the varieties. For the remaining four years, the average lodging for the various varieties was as follows:

I. P. 165=6·67 per cent, Pb. C 518=44·3 per cent, I. P. 125=38·3 per cent, I. P. 80-5=59·60 per cent, I. P. 114=37·5 per cent, I. P. 12=97·4 per cent and I. P. 120=59·6 per cent.

Light loamy land. Average of 2 years (1939-40 to 1940-41).

Variety	Yield in maunds per acre	
	Grain	*Straw*
Pb. C 518	29·53	58·59
I. P. 125	27·32	55·35
I. P. 12	26·53	49·84
I. P. 80-5	25·97	57·47
I. P. 165	24·26	45·29
I. P. 120	24·19	60·38
I. P. 114	23·56	54·07

There was practically no lodging in this area.

A study of the yields obtained in both cases shows that the varieties behaved differently in the two types of soils—rich and light. I. P. 165, which gave the highest yield on rich land, gave comparatively low yield when sown on light land. This is most probably due to its resistance to lodging when sown on rich land. As the extent of lodging in the other varieties was higher than I. P. 165, on rich land, their yields were adversely affected. On light land, on the other hand, lodging was practically absent in all the varieties, but the advantage of resistance to lodging was not of much help to I. P. 165. I. P. 165 gave a maund of grain more per acre than C 518 on rich land, but there was more straw to the extent of 12 maunds per acre in the case of the latter. On light land, however, C 518 gave higher yield both of straw and grain than I. P. 165.

I. P. 12, which is highly susceptible to lodging (97·4 per cent), gave almost the lowest yield of grain on rich land but ranked third in yield on light land, because it escaped damage from lodging in the latter case. Taking all the factors into consideration, of all the varieties tried, C 518 is the best type of wheat for both rich and light conditions of soil in Lyallpur.

Improved cotton in the Punjab

It is now abundantly clear that a single variety of cotton will not be suitable for the whole of the province. The present commercial strains are now being grown in well-marked regions. L. S. S. predominates in the districts of Lyallpur, Sheikhupura and Sargodha, 289F/43 in Montgomery, Multan, Muzaffargarh and Dera Ghazi Khan, 289F/K-25 in Montgomery and Multan, 39 Mollisoni in the central canal colonies, 119 Sanguineum in Dera Ghazi Khan, Muzaffargarh and Multan excluding the Khanewal sub-division, and M60A_2 in the south-eastern region. It is also now realized that quickest results can only be achieved by breeding new varieties in the tracts in which these are destined to be grown. Thus sub-stations have been provided at Multan, Khanewal, Jhang and Hansi for this purpose.

An important event of the year is the approval by the Punjab Department of Agriculture

of the new variety, 119 Sanguineum. The Department now recommends this cotton for growing in the districts of Dera Ghazi Khan, Muzaffargarh and Multan except the Khanewal sub-division. This variety is very early maturing, high yielding, with a high ginning percentage and drought resistance. The financial gain by growing this cotton in place of the ordinary varieties now being grown by the zemindars has been worked out at Rs. 10-13 per acre.

Due to the lack of export facilities during the war, the premium for American cotton was exceptionally high and went up to between Rs. 7 and Rs. 8 per maund of *kapas* towards the close of the season. This state of affairs is likely to continue till the end of the war. On account of this difference in the rate of the two cottons, the area under American cotton will increase at the expense of *desi* and the zemindars will have the temptation to grow American cotton even on marginal lands where the chances of *tirak* (premature opening) are very high. It is, therefore, imperative that some *desi* cotton should be evolved which should do well on such marginal lands and still command a good price. Jubilee cotton with its plant habit of *desi* cotton and lint approaching 4F in quality will, it is hoped, suit this purpose admirably.

Improved oleiferous Brassicae

As a result of investigations several improved strains of various oleiferous *Brassicae*, viz. *toria*, *sarson*, *raya* and *taramira*, have now become available and are being introduced successfully in different parts of the province. Recently some seed of a few improved strains has also been supplied to adjoining states and provinces. Every year increasing quantities of such seed are made available, the figure for the past season being 1,400 maunds sufficient to sow an area of 25,000 acres. A brief account of each of the important types is given below.

Approved Varieties

Toria selection A.—A variety evolved by mass-selection which, besides high yield, earliness and uniformity in maturity, possesses 3 to 4 per cent higher oil content than the local *toria*. It has become very popular among the farmers and its seed is being distributed on a large scale. During the last season 1,000 md. of seed sufficient to sow 16,000 acres was distributed by the Department.

Raya L-18.—A type evolved by pure-line breeding and suited to *rabi* sowings on account of its characteristically high yield of seed as well as fodder, drought- and disease-resistant qualities has attained considerable popularity with the farmers. Being self-fertile, it maintains its purity from year to year and is now greatly in demand. Every year increasing quantities of its seed are distributed, the figure for the last season being 400 md. sufficient to sow an area of 6,000 acres. Reports received from the district staff give a very good account of its performance on zemindará lands.

Varieties under large-scale tests

Raya L-16.—This new type evolved by pure-line selection combines the high yield of *raya* with the earliness of *toria*. It is proving a great competitor with *toria* against which it has been extensively tried during the past three years and has invariably outyielded it. Its self-fertility, which admits of high purity, is a further asset in its favour. This type appears to have a very bright future and is expected to play an important part in general farming practice. Though not yet on the approved list, demand for its seed is high.

Raya L-9.—This is another *raya* type, suited to *rabi* sowing. It is a promising type and is being subjected to further trials.

Brown sarson A.—This strain has been evolved by mass selection, and has given very encouraging results, both in yield and oil content when compared to the local strains.

Yellow sarson L-1.—A strictly self-fertile, pure-line selection, which is very much valued for its high oil-content of extra purity. It sells at a premium in the market. Its poor stand appears to be responsible for the low yield and attempts are being made to remove this defect by cultural treatment.

Poultry

With the advent of the hot weather the

price of eggs in the Punjab varied between two and three annas per dozen in the villages, and about four annas per dozen in the towns.

An enquiry at one of the hill stations in the Punjab revealed that there was a good demand for fresh and graded eggs for eating purposes during the summer months and that people were prepared to pay up to a rupee a dozen for such eggs.

A poultry-breeding cooperative society with twelve members has been started in one of the villages of the Gurdaspur district. The aims of the society are: (a) better poultry breeding, and (b) marketing of poultry products.

N.-W. F. PROVINCE SUMMER FRUIT SHOW

By R. Zarbakht Khan, B.Sc. (Edin.), C.D.A. (Wye)
Horticulturist, N.-W. F. P.

FRUIT shows have become a regular feature of the activities of the department of Agriculture in the North-West Frontier Province. Two shows are held each year in January and July. The summer fruit show for 1941 was held in the Edwardes College Hall, Peshawar.

The entries received numbered 735. These consisted mainly of peaches and grapes. Besides, other fruits and vegetables were also on display. Entries of peaches, plums, pears, grapes, pomegranates, water-melons and musk-melons were received from Peshawar and Mardan districts. Bannu sent water-melons, musk-melons, figs, mangoes and dates; Kohat guavas and plums; Dera Ismail Khan dates, musk-melons and mangoes; Hazara apples, walnuts, almonds, plums and mangoes; while the Malakand Agency sent apples, almonds and mangoes to the show. The exhibits, particularly of grapes and peaches, consisted of very high quality fruits.

Gay stalls

An outstanding feature of the show was the separate stalls set up by some of the associations. The Grape Growers' Society of Sheikh Muhammadi displayed their samples in a beautifully set-up stall. All the six varieties of grapes, i.e. Kishmish, Bedana, Tor, Spin Sahibi, Sur Sahibi and Toss, under commercial cultivation, were exhibited by them. Similarly, the Peshawar Vale Fruit Growers' Association set up a separate stall for their exhibits of beautiful peaches, plums, pears and fruit products.

Three competitors entered for fruit preserves. They exhibited their products on a separate stall, which consisted of dried fruits, canned fruits, jams, jellies, tomato ketchup and crystallized fruits.

To add to the educational value of the show, various sections of the Agricultural Department displayed their activities on the show premises. The Fruit section exhibited fruit varieties of excellent quality produced at the Tarnab Farm. By charts it was explained what could be grown in the province, and how to produce high quality fruits. Methods of packing, grading and picking were also demonstrated to the public. The Entomological and Mycological sections displayed the common pests and diseases of fruits and demonstrated the methods of their control. The Fruit Preservation section displayed their products and demonstrated preparation of jams, canning of peaches and drying of fruits. The Sugarcane and Chemical sections exhibited their activities at a separate stall. The Cooperative and Marketing Departments set up two instructive stalls.

Fruit for heroes

Hitler was also present on the stage, but this time, our men on the front, fed on Tarnab dried peaches and pears, were making him run for his life.

The staff of the Agricultural Department

The Peshawar Vale Fruit Growers' Association's preserves and products exhibited at the Summer Fruit Show

The Tarnab fruit products displayed at the Summer Fruit Show

delivered lectures and gave radio talks on agricultural subjects during the three days of the show.

The show proved very popular with the public. The hall was often full to capacity. Some of the distinguished visitors to the show included H. E. Sir George Cunningham, the Governor, The Hon'ble Lieut.-Col. W. F. Campbell, the Adviser, General Denning, G. O. C., Peshawar Command, Lieut.-Col. Diamond, Assistant Director of Public Health and Major L. W. C. Leeper, Secretary, Development Departments.

The prize distribution took place at 6 p.m. on the 20th July; H. E. the Governor gave away the prizes. At the finish, His Excellency, in a brief speech, congratulated the Department on the development of the fruit industry, and said that he was amazed to see that fruit-growing in the province has made so much progress in so short a time and that if the zemindars continue to take the same interest in this industry as they are doing now, the valley of Peshawar should become very prosperous on account of this new trade. Khan Mohd. Anwar Khan, Secretary, Fruit Growers' Association, Peshawar valley, thanked his Excellency for the Government's sympathy with the zemindars of the province and expressed his appreciation of the work being done by the Department of Agriculture for the benefit of the fruit growers.

The Month's Clip

WHAT IS RESEARCH ?

RESEARCH is largely an orderly thought process. It is not the random course of thinking as a mere chance occurrence. It is the reflective type of thought which involves a sequence of ideas. It is a consecutive ordering of ideas in such a way that each determines the next as its proper outcome, while each outcome, in turn, leans back on or refers to its predecessors. The successive portions of a reflective thought grow out of one another and support one another. They do not come and go in a medley. Each step must be from something to something. These thoughts become a definite chain, all linked together, so that there is a sustained and progressive movement to a definite end. The order may be from known fact to significance, to further significance; or from tentative theory to the conditions under which it would be true, to established fact or to apparent truth which can be checked by experiment.

Thinking is not a case of spontaneous combustion. It does not just happen to occur. The origin of thinking is some perplexity, confusion, or doubt. C. F. Kettering says: 'Research is not a thing you do in the laboratory. It is a state of mind.' It is an active state of mind prodded on and on in reflective thinking by intellectual curiosity and by dissatisfaction with the limitations of existing knowledge and resulting ways of living and working.

Research usually involves seeking the solution for some problem. The first step, therefore, is to note suggestions for a way out—the formation of some tentative plan; the entertaining of some theory or theories that will account for the peculiarities in question; the consideration of some solution for the problem.

The data at hand cannot supply the solution; they can only suggest it. Past experience and a fund of knowledge at one's command are the real sources. If one has had some acquaintance with similar situations, or if he has dealt with material of the same sort before, helpful suggestions will arise, but he must guard against being influenced by preconceived and unproven ideas. Tentative plans or theories must be checked back in reflective thought through the conditions under which they would be true, to the possibility of such conditions, existing as verified or disproven by known fact or experiment. And the basic data thus determined to bear on the problem and its solution should be checked forward again by reflective thought from proven fact to its primary significance, through any number of successive derived significances, to a resultant significance which may prove, disprove, or improve the tentative solution. Experimenting and testing are not research, but can be valuable aids to this work of checking on the mental processes of research and on the data used.

Agriculture embraces many associated sciences. These sciences are all so interrelated that if they advance, they must all advance together. Like the moving parts of a machine, each science must perform specific functions and must be so coordinated with the others that all move together according to their functional relationships. Each science has in its accumulated knowledge, techniques, and the experience of its personnel, the soundest basis for reflective thinking in its field. With high standards of professional cooperation, the reflective thinking of representatives of all of these sciences can be jointly applied for maximum effectiveness in solving the many agricultural problems which transcend the boundaries of any one science.—E. A. SILVER, Chairman, American Society of Agricultural Engineers Committee on Research, in *Agricultural Engineering*, January 1941.

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CATTLE FOR EXHIBITION

IT is still a common occurrence at shows to see poorly prepared or even unconditioned animals in the ring. And yet the purpose

of exhibiting animals at shows is first and foremost to afford breeders an opportunity of advertising the quality of their cattle and of comparing them with those of other breeders.

The animal selected for the show should not only be pure-bred and truly representative of its breed, but also true to the desired type.

Prior to the show the animal should be fed a good ration according to its condition. It is obvious that any inherent good qualities cannot find expression unless the animal is correctly fed and receives the necessary treatment. The feeding should be such as to enable the desired inherited qualities to develop to their fullest extent.

Careful attention should be paid to the animal's disposition. In the ring it should be docile and tractable without losing its spiritedness. This characteristic can best be cultivated by frequent handling of the animal and by leading it around and accustoming it to such treatment as will be experienced in the ring. Here its gait and stance are of the utmost importance. By assiduous and regular training the animal should be taught to stand correctly and squarely. It should assume a proud bearing with its head held high and its back straight, and should stand straight and squarely on all four legs. In view of this it is important to pay timely attention to the hoofs which are sometimes so badly shaped that the animal cannot walk or stand properly. Such hoofs should be rasped to the correct shape and then be smoothed by polishing.

In the case of older cattle it may also prove necessary to smooth the horns by rubbing and then polishing them with olive or salad oil.

In order to show up the udder and milk veins of dairy breeds more prominently, it is often necessary to shear part of the udder, belly and inguinal regions. Care should be taken, however, that the shorn hair gradually merges with the unshorn coat. The same applies to the tuft of the tail which should be trimmed to a well-shaped plume. The animal should also be brushed regularly and frequently with a hard brush and then rubbed with a piece of cloth.

Immediately before the show, the animals should be washed regularly and kept clean. After the animal has been washed, white patches on the coat should be bleached with blue in order that they may appear a glossy white. The tuft should be tightly plaited into strings and loosened shortly before the show.

As mentioned above, neatness is an important consideration in the ring. Immediately before being exhibited, the animal should be rubbed with a cloth soaked in a little olive or salad oil. This imparts a soft lustre to the coat. The leader should see that the animal walks correctly in the ring. He should watch the judge carefully and make sure that when the order is given for his charge to stand, the animal stands correctly and squarely on its feet.

For farmers shows are what display windows are to the shopkeeper, and the exhibitor will find it worth his while to observe neatness and preciseness on all such occasions. (P. C. de Villiers, Extension Officer, Vryheid.)

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RABBIT FOR MEAT AND FUR

THE rearing of rabbits for meat and fur is of considerable economic importance. Under natural conditions, it is stated, the rabbit generally lives on fresh or dried green food ; but when required to do so it can be used as a means of converting waste products and vegetation not used as human food into food of high biological value for man and that it produces fur at the same time. The density of the population, like that of other wild animals, depends on the available food supply and some observers believe they have traced definite cyclical changes. The domesticated rabbit has been found to be highly adaptable in its feeding habits, and feeding practice depends more on the nature of the feeding stuffs available than on accurate knowledge of the best type of diet. It is frequently stated that the hutched rabbit does not flourish on greenstuffs alone but usually no explanation is offered. It would appear that the reason may, in part, be found in the low energy value of most greenstuffs relative to

their bulk and the rapid growth of 'improved' breeds of rabbits.

Growth and health

It is well known in animal feeding that growth is most rapid and production highest when health is best; it is equally true that, when growth and production rates are highest, health is most difficult to maintain. It has been shown that adequate supplies of energy, protein, certain vitamins and minerals, especially calcium and sodium chloride, and water are necessary. Since green food supplies protein, vitamins and minerals in relatively large amounts, and grain foods supply energy with relatively little of these other substances, it follows that deficiencies are much more likely to occur with winter rations than during the summer and to affect the growing stock and breeding does more than resting adults. From experience with other animals, it would be expected that insufficient feeding, and deficient diet, would affect resistance to infective disease. There can be no doubt, for instance, that deficiency of vitamin A would reduce resistance to certain bacterial infections.

Different breeds of rabbit vary more in adult weight than any other type of domesticated animal. Hence, any general standardisation of feeding practice on an age basis is impossible and all rationing must be planned with reference to the size and rate of growth or production of the breed in question. In the pregnant rabbit the weight of the fœtus is only 3 g. at 20 days but from 20 to 30 days it increases, on the average, by 44 g. and the birth weight is affected by the feeding of the doe during the last 10 days of pregnancy. Fattening should be avoided, since it produces smaller, instead of larger young, but the ration must be adequate to ensure satisfactory birth weights and good milk production. The very high protein and mineral contents of rabbit milk are associated with the rapid rate of growth of the young. Since the concentration of nutrients is so much higher than in cow's milk, and yield at the height of lactation is also very high, it follows that the lactation requirements of the rabbit are relatively much higher than those of the cow.

Choice of foods

The foods commonly used for rabbits include greens and roots in great variety, hay and cereals with additional protein and oil foods for high condition. Feeding systems may easily be adjusted to utilize any waste products and fodders available locally. The proportions of green to dry food may vary widely according to available supplies. Details of many rations are presented and, from these, rations may be selected, or modifications made, to suit local conditions. The two main considerations governing the choice of foods ought to be, to secure a balanced ration from the available foods, and to keep the cost of feeding as low as possible. The possible choice of foodstuffs is wide. The 'available' foods vary from one country to another.

Green food

An almost endless variety of plants may be used to supply green food. In intensive practice, however, where large quantities are required daily, the tendency is to replace natural herbage by cultivated crops, especially in winter, and to use roots as partial substitutes for green, leafy food. In view of the difference in composition of these two types of food, however, it should be remembered that when roots are used, the supplies of calcium and protein for growing and lactating stock require to be made up from other sources. With regard to the use of herbage, it should be remembered that fibrous material is not well digested or utilized. With such material, weight and dry matter do not give a reliable guide to nutritive value. Experiments in which the nutritive values for young rabbits of manured and unmanured pasture were compared showed that the rabbits fed on fertilized grass (air-dry, with 1 per cent of salt) grew much better than those on unfertilized pasture. When supplements of casein and cystine were added to the unfertilized pasture, the two became approximately equal in value. The same worker also found that dried timothy gave better results than dried reed canary grass as the sole diet of growing rabbits. Hutched rabbits do not maintain condition, or grow at the normal rate on a ration of

greenstuff and hay alone. It has been seen that the utilization of hay is poor and that excess of fibre depresses the utilization of other constituents of the ration. On the other hand, it is difficult to explain why both adult and growing rabbits in outdoor runs on good growing herbage should grow as well as intensively fed hutched stock. It appears that exercise may play an important role.

Concentrates

A great number of studies have been made to compare the nutritive value for rabbits of different cereals and of seeds used as sources of protein. In America, maize was rated as of slightly higher value than oats, wheat or barley, which were graded in that order. (This is not in agreement with the results of Bruggemann's digestibility trials.) Soya bean meal, moistened, was found to be about 10 per cent better than peanut meal, dry soya bean meal or linseed oil meal. On the other hand, when rabbits were given free choice of cereals or of oilseeds, the orders of preference were: oats, wheat, barley, peanut, soya bean, sesame, linseed, cottonseed and hempseed. In addition to oilseeds and legumes, other protein concentrates used with success are milk, fresh or dry, fishmeal, meatmeal and meat- and bonemeal, and for particularly rapid growth of giant breeds, chopped fresh meat has been used. It is important to remember that plant protein concentrates other than legumes, and meat without bone, supply very little calcium and that, therefore, a supplement of calcium will be required unless a large part of the ration is green food, and probably even with some kinds of green food.

Methods of feeding

When green food is intended to form a large part of the ration, it should be wilted before feeding in order to reduce the bulk. Pelleting the concentrates eliminates wastage but early attempts to feed rabbits on pelleted rations broke down on account of impaction paralysis. This is obviated by provision of green food and water, and pelleted concentrates, in spite of their high cost, are now extensively used by rabbit farmers in California. All-mash rations, even with green food, have not been found suitable for young rabbits. The number of feeds given daily varies. Adults are usually given two, young rabbits three or even four. The dry matter content of a ration determines to some extent the amount that will be eaten. Ashbrook states that a breeding doe requires daily $\frac{1}{2}$ to $\frac{3}{4}$ oz. dry matter per pound of liveweight.

Maintenance rations

In practical rabbit farming, maintenance usually implies more than merely maintaining a stationary body weight. A healthy adult rabbit continues to make small weight gains during most of its breeding life. Further, practical rabbit farmers usually require 'non-productive' animals to improve in condition as a preparation for breeding or require them to grow new coats of wool. Hence, a rabbit that merely maintains its weight is not, under normal conditions, adequately nourished. It should be noted, therefore, that, theoretically, maintenance rations for stock expected to improve in body condition or clipped for wool should exceed the true maintenance requirement. An extensive series of rabbit feeding tests with fur and wool breeds has been carried out by King Wilson at Harper Adams College. For maintenance, two feeds were given daily: dry mash and either poor hay or green food in the morning and grain and green food in the afternoon. In winter, oats partly replaced the green stuff. Various ratios of dry food to green (or root) foods have been used. The general recommendation arising from these trials for the maintenance of medium-sized rabbits is 1 oz. of dry mash, $\frac{3}{4}$ oz. of oats, 2 oz. of hay and 4 to 12 oz. of green food or roots daily. When green food is plentiful the amount of dry foods is reduced and greenstuff increased from 8 to 15 oz. When green food is scarce the hay allowance is increased. The mash used in the stock diet consisted of 40 per cent yellow maize meal, 40 per cent Sussex ground oats, 10 per cent wheat bran, and 10 per cent white fishmeal, freshly mixed at intervals of not more than one month. For another group the mash was made of bran 62·5 per cent, sharps 12·5 per cent, barley-meal 12·5 per cent,

white fishmeal 6·25 per cent, and linseed 6·25 per cent. This replaced both the control mash and the grain. Owing to the bulky nature of this dry mash with its high bran content, consumption by the latter group was slightly lower than by the control group. At the end of one year's feeding the body-weight was almost identical with that of the controls but condition was slightly inferior. In another test bran replaced the mash portion of the control ration, and at the end of one year's feeding the bran group had lost an average of 2 oz. liveweight while the controls had gained an average of 13 oz.

Production rations

Various studies have been made of food consumption to produce 1 lb. increase in weight in young rabbits but, since gross weight of food gives no indication of the nutrients consumed or of the efficiency of conversion, it is not thought profitable to discuss these results until further data are available.

Quality of product

The principal British markets for table rabbits require a medium-sized carcase, well covered with muscle and without too much fat. The fat should be as white as possible, and the flesh should be free from strong feed flavours. In order to fulfil the first demand, smaller medium breeds are popular as they provide the ideal type of carcase when pelted although larger types will reach the desired weight at a much earlier age. The ratio of carcase weight to liveweight increases from just over 50 per cent in young rabbits to between 60 and 65 per cent in young adults. Hence, to give a dressed carcase weight of 2½ to 3 lb., a minimum liveweight of from 4 to 5 lb. is required. The dressed carcase yield and the proportion of edible meat in the dressed carcase partly depend on feeding. Hammond has shown that the ratio of edible meat to carcase at birth is only 66 per cent and that it increases to 82 per cent in the adult. The better the animal is fed the higher the ratio will be. In the early stages of growth there is no difference between male and female animals, but later the female gives the higher proportion of edible carcase, chiefly because of a higher fat content. Analyses have shown that the composition of rabbit meat is similar to that of chicken and it is as easily digested. Protein is from 18 to 22 per cent. Fat varies widely with age, sex and diet, with a range from about 2 to about 22 per cent. The flesh of rabbits fed on grass alone tends to be dark red; but this can also be avoided by using foods of low xanthophyll and chlorophyll (colouring matters in plants) content in the finishing ration.

Various special feeds and special supplements have been recommended to improve the quality of wool and fur. Paice says that milk improves the gloss of the wool and doubles the fat content of its fibre. Pickard found that special supplements of calcium alone or mineral mixtures depressed wool growth but that cod liver oil, 3 drops daily, 6 days a week, increased the clip by 13 per cent. It also counteracted the depressant effect of the calcium supplement. Wirth feeds both calcium and cod liver oil, and other workers claim good results from using oilseeds in the ration for fur rabbits, ranking linseed oil meal as superior to soya bean or peanut. The importance of an adequate supply of water for wool production and of salt for maintaining a healthy condition of the skin have already been noted. American workers have found that rabbits, when they are moulting, consume slightly more salt than usual. Reference has also been made to the fact that supplements of iodine have been found beneficial. Cunningham showed that black fur contains more copper than white fur and Gorter that deficiency of copper will cause depigmentation of fur. Deficiency of copper is, however, not likely to occur with mixed rations.

Economics of rabbit production

Compared with the milk cow, or larger meat producing animals, the rabbit is relatively inefficient in the conversion of plant food to meat, but its advantage lies in its adaptability to use what would otherwise go to waste. Furthermore it can be reared in practically every garden in both town and country, where there is no room for larger

stock. The price of the carcase, as meat, will commonly cover the food cost of rearing and the price of the pelt be gross profit. In the case of table rabbits the food costs are much lower, owing to the earlier killing age. —W. KING WILSON and W. MCCARTNEY, *Rabbit Feeding for Meat and Fur*, Technical Communication No. 12, Imperial Bureau of Animal Nutrition, September 1940.

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BONEMEAL IN DAIRY RATION

THE results of this experiment show conclusively that no outstanding deficiency of minerals resulted under the prevailing conditions when the cows were fed a ration containing no bonemeal. These cows were fed corn silage and a good grade of timothy hay as roughage during the winter feeding season and were all grazed during the summer months on pastures treated with mineral fertilizers. This pasture may have helped out in supplying any possible deficiency of minerals. The blood calcium and phosphorus were normal on all cows even when not on pasture.

The differences in the results between the bonemeal and the no-bonemeal rations were very small, and were not consistent enough to indicate any particular advantage from feeding supplemental bonemeal. The average daily production of milk for the lactations on bonemeal was exactly the same as that when no bonemeal was fed. When the first 200 days of the lactation periods are considered, the daily production on the bonemeal ration was only 0·5 pound higher. Approximately half of the cows produced more on the basal ration and about half produced more on the bonemeal ration. The data obtained on the weight and health of calves and on the number of services necessary for conception are slightly favourable to bonemeal.

The general results of the study herein reported are in agreement with the results of an extensive study on the mineral requirements of milk production conducted by the Institute of Animal Nutrition of the Pennsylvania State College Experiment Station (1). The producing ability of the animals used for this experiment was probably representative of the producing ability of the majority of cows owned by commercial dairymen. These results lead to the conclusion that the ordinary Pennsylvania dairyman, unless he has unusually high producers, does not need to add bonemeal to the dairy ration as cows on this experiment producing up to 12,000 lb. of 4 per cent fat-corrected milk did not appear to be benefited materially by the feeding of supplemental bonemeal.—*Pennsylvania State College Bulletin.*

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WORMS IN PIGS

THE control of the common round white worm of pigs is of first importance in swine production. These worms may usually be found in small numbers in the best-kept herds but may be controlled by simple methods regularly practised. On the other hand, if no action is taken against them, serious losses may result, says E. Van Nice, Dominion Experimental Station, Scott, Sask.

It is best not to wait for signs of worms but, through regular preventive measures, see that the signs do not appear. Control measures consist of giving pigs new yards once per year if possible or at least ploughing the land and seeding to some annual crop. Since the greatest losses are usually before weaning, this is the logical time of attack. The mother may be treated for worms at least a month before farrowing by use of the following mixture :

For each 100 lb. weight of the sow or sows to be treated, mix one tea-spoonful of gasoline, one teaspoonful of turpentine, and four tablespoonfuls of raw linseed oil with one quart of milk. Starve the pigs 24 hours, place mixture in trough and leave until consumed. Starve another three hours ; then feed as usual.

When the sow is put in the farrowing pen, the lower half of the body, particularly the udder, should be washed with warm water and laundry soap to remove worm eggs adhering. The pen should be cleaned thoroughly and scrubbed with hot lye water—one pound of lye to 40 gallons of water—to kill any

worm eggs. These are too small to see readily. Repeat this cleaning and washing once every ten days until the pigs are weaned, then provide fresh land for the pigs.

After the pigs are four months old, the danger from worms is not great. The adult pig seldom suffers greatly from the presence of worms; but, as the eggs are passed with the fæces, the pens and pastures thus become polluted. The worm eggs may remain in the soil under favourable conditions for a year or more and be picked up by pigs with their food.—*Press Note, Dominion Department of Agriculture, Canada.*

New Books and Reviews

The Production of Lime Oil and Calcium Citrate in the Province of Bombay

By M. S. Patel, M.Sc., Ph.D., and M. N. Kale, M.Sc., Bulletin No. 11 of the Department of Industries, Bombay. (Superintendent, Government Printing and Stationery, Bombay, 1938, pp. 24, 6 as.)

THIS bulletin, published in 1938, has recently come to our notice and is a full and detailed account of the starting of a new industry. The bulletin is fully illustrated with photographs, diagrams and graphs. Costs have been very carefully worked out. We understand that the grower on whose plantation this work was done has, in the course of the last few years, produced some 6,000 lb. of lime oil in this manner worth about Rs. 60,000. It is worthy of note that the Indian *kagadi* or *kagazi limboo* gives an oil of a fine aroma which is liked by buyers. [W. B.]

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The Bombay Karnataka: A Geographical Survey

By B. S. Sheshgiri, B.Ag., B.Sc. (Lond.), M.Sc. (Cantab.), with 9 plates and 22 maps and sketches. (Available from the author at the Lingaraj College, Belgaum, 1941, pp. 208, Rs. 2.)

PROF. B. S. Sheshgiri's book is a mine of valuable information regarding one of the most important tracts of the Bombay province. The chapters dealing with agriculture are of special interest to agricultural teachers and students and contain much data regarding crops presented in an attractive and convenient manner. The book is illustrated by photographs and maps which enhance its value as a work of reference. The appendices are carefully compiled and present useful statistical information regarding the rainfall, temperatures, cultivation and crops in the area surveyed. Prof. Sheshgiri has drawn on many sources for the mass of information contained in his book and has succeeded in presenting a very complete picture of the natural, agricultural and economic conditions of the Bombay Karnataka. Similar surveys of other homogeneous tracts in India would not only be of extreme value to students but would also appeal to a much wider range of readers. [W. F. J.]

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A Review of Agricultural Investigations on Jute in India

By J. S. Patel and R. L. M. Ghose (Published by the Secretary, Indian Central Jute Committee, Calcutta, 1940, pp. 44, Re. 1-8 or 2*s*. 3*d*.)

THE saying 'Happy is the land which has no history' might be paralleled by one noting the correlation between lack of literature and absence of selling problems in jute. The situation has been changing, however, ever since the boom which followed the war of 1914-18 and the speed of that change has been increased immensely by the present war. Study of the crop and plans for assisting it have been handicapped by lack of an authoritative background of literature. Dr Patel, Jute Specialist, and Mr Ghose, Botanist to the Indian Central Jute Committee, are to be congratulated therefore on having brought together in their review the whole of the material, much good and some not so good, which is available from the records of the Bengal Agricultural Department. It must have been a weary task, but it has been competently done and presented in an interesting manner. They have naturally found gaps in the experimental work of their predecessors in Bengal of which the failure to test the effect of lime alone as a manure may be noted, but they have found much to approve of as well, notably in the work of Finlow.

Having laid such a sound base, the experimental structure to be erected on it will be awaited with much interest not only in the jute-growing provinces of India, but in fibre-producing lands everywhere. [W. M. C.]

The Principles and Practice of Feeding Farm Animals

By E. T. Halnan and F. H. Garner (Longmans Green & Co., London, 1940, pp. 360, 15s.)

THIS publication is a welcome addition to the existing literature on animal nutrition. The authors state that they have tried to meet the demand for information of both the scientific worker and the practical farmer by explaining in simple terms the principles of nutrition and the application of these principles to the feeding of livestock. In so doing they have further endeavoured to maintain a proper balance between the natural enthusiasm of science and the practical points of good husbandry; none too easy a task, since it is generally admitted that the scientist and the husbandman have always proved uneasy bed-fellows.

The book is well written. It is divided into two sections, in the first of which theoretical considerations such as the chemical composition of the feeding stuffs and animals, the fate of food in the animal, biological values of feeding stuffs and feeding standards are discussed. In the second section, various topics such as the feeding of different types of farm animals, the common feeding stuffs of the British Isles and their utilization, etc. are discussed from the practical point of view. An interesting chapter in this section deals with the feeding practices in war-time. The first section thus deals with general scientific principles and follows the usual practice in other well-known textbooks, while the second section will appeal more to the farmer engaged in animal husbandry work in the British Isles. [K. C. S.]

From All Quarters

SHEEP AND GOATS CLASSES

At a meeting held on 1 July 1941, the Executive Committee of the All-India Cattle Show decided to introduce classes for sheep and goats at the forthcoming cattle shows in New Delhi and the western and southern regions. The details of the classes and prizes for each breed will be published in the prospectus which will be issued shortly. The following is the allocation of the breeds to the different regions :

	Sheep	*Goats*
Delhi—		
	Balkhi	Barbari
	Bhadarwah	Betal
	Bikanir	Chigu
	Gaddi	Daradin Panah
	Gurez	Gaddi
	Hashtnagri	Jamnapari
	Karnah	Sirli
	Lohi	
West—		
	Bibrak	Kamori
	Deccani	Lehri
	Harnai	North Gujarat
	Kuka	Surti
	Kajilo	
South —		
	Bellary	Malabar
	Hassan	
	Mandya	
	Nellore	

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INDIAN CANES ABROAD

The sugarcanes Co 419 and Co 421, bred at the Imperial Sugarcane Station, Coimbatore, have done so well in several tracts in India that their performance at certain places outside India is not without interest. Two such reports on Co 419 and one on Co 421 are now available.

In Trinidad (Field Experiments on Sugarcane, Annual Report for 1940) the yields of Co 419 and Co 421 were 57·20 and 49·59 tons per acre respectively as against 48·78 tons from F. C. 916, 41·00 from B. H. 10 (12), 39·32 from Co 313, 29·60 from C. P. 28/11 and 28·47 tons from C. P. 28/19. Co 419 thus gave a significantly larger yield of cane than any of the other varieties. Co 421 and F. C. 916 were significantly superior to B. H. 10 (12) which was in its turn significantly superior to only C. P. 28/11 and C. P. 28/29.

In the same report another experiment with the varieties Co 421, Co 419, Co 213, Co 290 and Uba is mentioned. The yields of cane per acre were 45·48, 41·78, 39·06, 30·10, 31·54 tons respectively. Co 421 thus gave a significantly larger yield than any other variety. Co 421 also gave plant cane of much higher quality than any other variety as the figures for tons of cane per ton of sugar were 7·76, 8·30, 8·92, 8·40 and 9·30 respectively. As a consequence of this, Co 421 gave by far the largest yield of plant sugar. The actual figures for tons of sugar per acre were 5·87, 5·03, 4·38, 3·58 and 3·39 respectively.

In British Guiana (*Sugar Bulletin No. 9*, 1940) Co 419 was tried along with four other varieties and gave a yield of 50·19 tons of cane per acre. The other varieties were POJ 2878, Co 290, D 32/35, D 361/35 and yielded 41·35, 40·99, 31·89, and 26·86 tons of cane per acre respectively. The report adds, 'The recently introduced Co 419 was outstanding, especially as regards tonnage. If it maintains the promise it has shown here and in the nurseries at Sophia, this cane is likely to be of considerable service.'

The above-mentioned good performance of the Coimbatore-bred canes in the home of the famous Barbados and Demerara canes is noteworthy. It may be recalled that the British West Indies were among the very first—the other being Java—to improve their industry by the breeding of new varieties. Demerara also was one of the early centres of production of new varieties. If the Co canes keep up to their early promise in Trinidad and British Guiana, they will afford yet another instance of the service of Coimbatore to the countries of the British Empire.—N. L. Dutt, Imperial Agricultural Research Institute, New Delhi.

MOLES HELP WAR EFFORT

FURS valued at £100,000 from many parts of the British Empire—including moleskins from England and Scotland—are on their way to Canada to help pay for the United Kingdom's war supplies.

All these beautiful models have been processed and made up in London, but the skins come from all over the world. There are Canadian sable, mink, ermine, beaver, squirrel and musquash, Persian lamb, Russian ermine, South American ocelot, neutria, civet cat, and various skins from Newfoundland.

Britain's own contribution is moleskin, a fur which sold better than any other in a recent Canadian sales drive. It is also becoming very fashionable in the United States.

A mole-catching campaign in the English and Scottish shires has produced something like 5,000,000 moleskins, and when the season reopens in December next a fresh drive will be made. As most of Britain's professional mole-catchers have disappeared, men are being trained specially for the job.

The average moleskin coat requires 400 skins, and no fewer than 3,000 nails are required to pin them out for treatment.

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THOUSAND-YEAR-OLD CATTLE

PARK cattle, descendants of the gigantic white beasts that once roamed wild through Britain's forests, are today setting up new milking records.

The cattle owned by Sir Claud Alexander, Bt., of Faygate, Sussex, last year attained an average milk-yield for the herd of 8,060 lb., with a butter fat content of 4·50. In the previous year one heifer gave 11,724½ lb., and was fifth best heifer of all breeds in the West Sussex Milk Recording Society's books.

Park cattle are both the oldest and youngest of British breeds—oldest in respect of their long lineage, and youngest in that they made their first appearance in the ring at the Royal Agricultural Society of England's 1920 Show. The first volume of the Park Cattle's Society's Herd Book was published in 1918 and dealt with all the animals then in existence.

A vivid white in colour, with ears, muzzle, teats and eyelashes black or red, they are large, magnificently proportioned beasts, adapted to both milk and beef production.

Park cattle are remarkably free from tuberculosis. Major Gurney's herd of 150 head, no fewer than ten of which have earned the Ministry of Agriculture's 3-year Certificate (for a yield of 24,000 lb.), have all passed the tuberculosis test for several years in succession without a single reactor. This herd has averaged 7,859 lb. of milk annually over a period of 15 years.

***

RESTAURANT STRAWS

PAPER straws for sipping fruit juices and cold drinks are usually imported from the United States of America and some European countries. But owing to war their import is more or less cut off. Most of the restaurants, milk-bars and soda fountains may be finding it difficult to offer straws with their drinks. I would suggest the use of wheat straws instead of the usual paper ones.

The straws can preferably be gathered from the standing wheat crop. Arrangements could be made with cultivators who will be prepared to sell a portion of their crop at nominal cost after of course taking off the ear-heads. Suitable straws can also be selected from the undamaged harvested bundles of wheat. These straws could be cut to any suitable size and sterilized. The most usual size for a straw is about nine inches.

The golden yellow colour of the straw makes it attractive and provided undiseased and uniform straws are selected, I am sure the majority of users will really appreciate them.—S. M. WALANKAR, Kothi, Central Farm, Ujjain, C.I.

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J. P. TRIVEDI

ON May 2 of this year Mr J. P. Trivedi, L.C.E., who was for many years Professor of Agricultural Engineering, Physics and Mathematics of the Poona Agricultural College, passed away at the age of 55. At the time of his death, he was in charge of the newly started Anand Agricultural

Institute (in the Bombay Province) which he had taken over in January 1940.

Prof. Trivedi came to the College of Agriculture, Poona, on 26 August 1919, from the Public Works Department, in which he had been an engineer with considerable experience of both the civil engineering and the irrigation sides. He made the teaching of his subjects bright, interesting and practical and had a great share in the several remodellings of the Agricultural College course which took place during his association with the College.

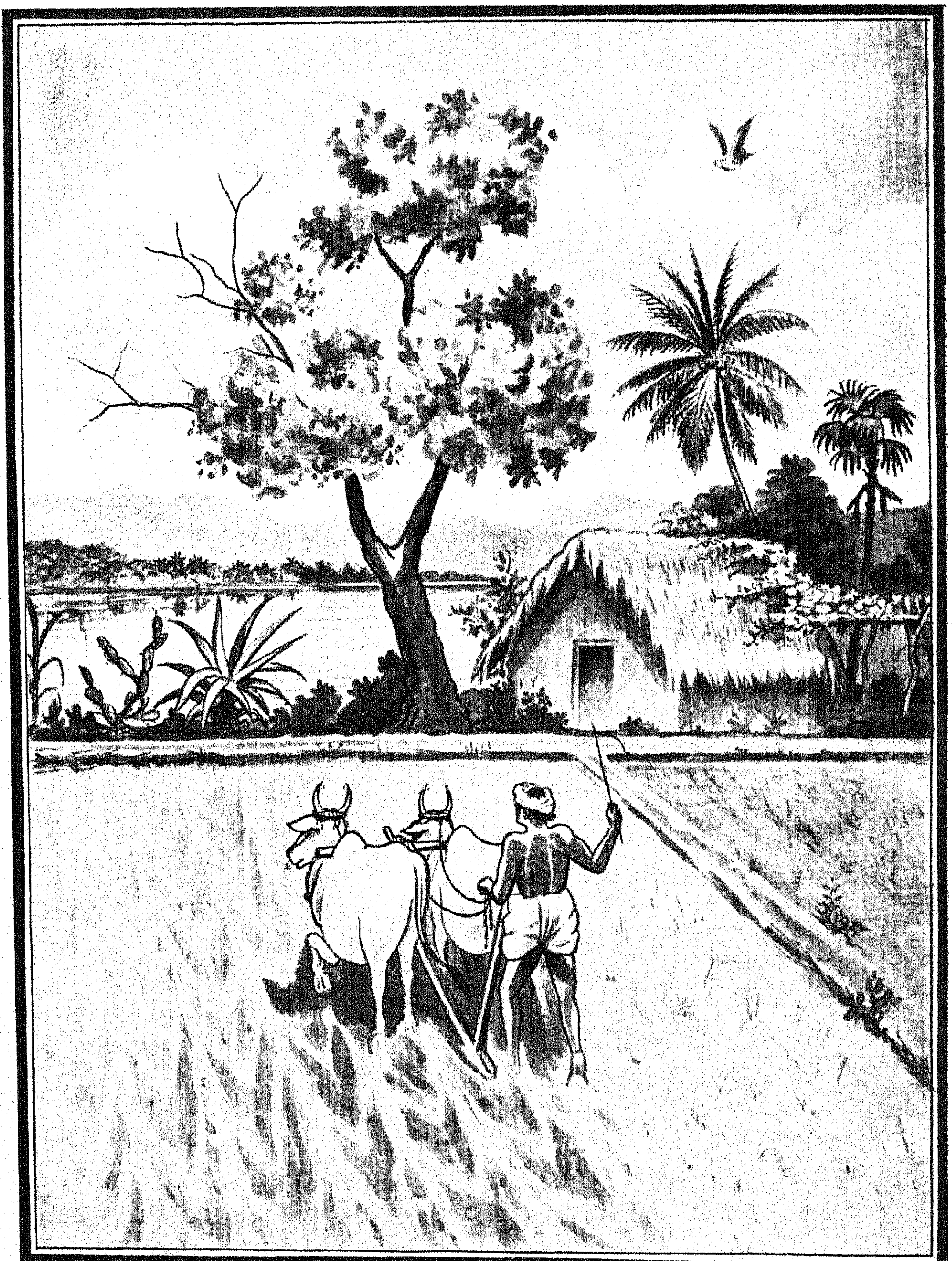
Amongst students he was at all times a tremendous influence for good. For a long time he was a Commissioner of the Boy Scouts and it was due to him that a troop of Rover Scouts existed at the College of Agriculture. He was largely responsible for the inception and organization of the Poona Inter-Collegiate Sports (a big annual event of the Olympic type) of which he was Secretary for the first two years. His generosity was of the most open-handed kind. He will be long remembered by Poona students. [W. B.]

THE FIFTH ALL-INDIA CATTLE SHOW

WILL BE HELD AT THE FOLLOWING REGIONS:

Western Region (Bhabnagar)	**from**	**10th**	**to**	**13th December 1941**
Southern Region (Bangalore)	**,,**	**17th**	**,,**	**20th January 1942**
Northern Region (New Delhi)	**,,**	**16th**	**,,**	**21st February 1942**

MGIPC—M—III-1-99—5-11-41—1,800.



The plough makes many Vs for victory

[PLATE 154

INDIAN FARMING

ISSUED BY
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

Vol. II DECEMBER 1941 No. 12

INDIAN AGRICULTURAL JOURNALS

THE interest displayed in the agriculture of a country may, to some extent, be judged by the number of periodicals devoted to that important subject, particularly those which are run by private enterprise and are not official organs. No survey has yet been made of Indian agricultural journalism but it is a fact that there are many more periodicals devoted to agriculture in India than are known to the general public. Of these, there are a considerable number in various Indian languages.

Amongst such journals, there is, for example, the *Khayaban* published in Delhi. This is printed in Urdu and, in addition to articles dealing with agriculture and animal husbandry, also has articles devoted to health, sanitation and to general news. In Marathi, there is *Shetaki ani Shetkari* which is now in its 32nd year and is therefore one of the oldest of the journals. It is the organ of the Deccan Agricultural Association with headquarters in Poona and depends a good deal for its articles on the work and writing of the Bombay Agricultural Department. In Hindi there is the *Kisan* published in Patna. This is now in its sixth year and has an attractive cover, indulges in a coloured frontispiece and goes as far as having poetry and dialogue. The Punjab has got two Anglo-Urdu journals—*The Punjab Fruit Journal*, which is the organ of the Punjab Provincial Fruit Development Board, Lahore, and is very up-to-date in all its articles. *The Punjab Veterinary Journal* edited for the Punjab Veterinary Association, is a smaller but also very useful journal in both English and Urdu. In Bengali, there is *Sonar Bangla*, now in its 16th volume which deals with both agriculture and rural uplift, and the *Krishi Katha* issued by the Department of Agriculture, Bengal, well-printed and handy. *Varthaga Oolian* is an Anglo-Tamil journal published in Trichinopoly. *The Journal of the Indian Merchants' Chamber*, which is an Anglo-Gujerati monthly published in Bombay, has occasional articles on agriculture or agricultural finance in one or both languages. *The Hyderabad Farmer*, published by the Hyderabad Farming Association, appears in English, Kanarese and Urdu. The Trichinopoly District Agricultural Association issues a journal in English and Tamil.

On the purely English side, there are a number of journals emanating from Agricultural Colleges or Agricultural Departments—such as *The Poona Agricultural College Magazine, The Nagpur Agricultural College Magazine, The Cawnpore Agricultural Students' Union Magazine, The Allahabad Farmer* (which emanates from the Agricultural Institute, Allahabad), and *The Madras Agricultural Journal* published by the Madras Agricultural Students' Union. The planting industry has got *The Planters' Chronicle*, (the official organ of the United Planters' Association of South India), *The Planters' Gazette and Annual*, and the *Planters' Journal and Agriculturist.* Jute has got *The Jute Journal* (the organ of the jute and gunny industries), sugar has *Indian Sugar* (the official organ of the Indian Sugar Syndicate Ltd.), while cotton has *The Indian Textile Journal*, which recently celebrated its jubilee. This is not by any means

a complete list. It is plain, therefore, that there is a fair number of agricultural journals in India but the probability is that only in a few cases is there a really large circulation.

Increase of circulation is a problem that confronts all journals. It is suggested that the agricultural journals in Indian languages might be utilized to a much greater extent, apart from their technical value, in some of the following directions:

(1) as reading books for the increase of literacy amongst cultivators,

(2) as reading books for officers learning the languages in which these journals are written (when one considers the uninteresting and doubtfully useful material that one has often to study, one feels that agricultural journals in Indian languages would make better textbooks),

(3) for reading material for the Indian Army both in India and Overseas and of course for all rural workers, cooperative societies, rural schools and village reading rooms.

A journal meets its cost not only from subscriptions but out of the income from advertisements. The advertisements, however, depend largely on circulation. Agricultural journals would attract the attention of advertisers much more if they could show considerably increased circulation.

While it is doubtful if there is any case for the starting of new agricultural journals in India, there is certainly a case for the strengthening of the position of those now being published.

Incidentally, it is worth while bringing once again to the attention of all concerned that any articles appearing in INDIAN FARMING can be reprinted or translated into any language with no conditions except the acknowledgment of the source of the article.

Original Articles

INDIA'S MILLIONS AND THE FOOD CYCLE

By Gilbert J. Fowler, D.Sc., F.I.C., F.R.San.I., F.N.I.

THE true poet in his moments of inspiration voices eternal truths and often sums up in his song what may be described in detail in many ponderous volumes published by the scientist or philosopher. Such a truly poetic summary is found in the lines of Shelley :

> Nothing in the world is single,
> All things by a law divine
> In one another's being mingle—

It has seemed worth while to follow the implications of these lines into the life of the growing plant and to consider the numerous factors involved in this comparatively simple natural process, and how these factors are inter-related. There is an increasing feeling among scientific workers that departmentalism in scientific research is becoming excessive so that each worker tends to be confined in a little cell by himself and is virtually unaware of the bearing of his results on wider issues, and consequently his own work lacks inspiration. This thesis has been developed in a recent volume : *An Agricultural Testament* by Sir Albert Howard. It has seemed to the present writer that it would not be unprofitable in a general article intended to appeal to the lay public to endeavour by a suitable example to show the inter-relation of the many avenues of scientific research which lead to the building up of the living plant. In the life of the growing plant are concerned sunlight, air and water, soil and soil organisms, plant food and the harmonious cooperation of insects, animals and men. A consideration in some detail of these factors may, apart from its intrinsic interest, help to unfold possibilities of new paths of research and in harmony with Shelley's lines, indicate the bearing of these things on human life in general.

Sun's energy

We may take these factors broadly in order beginning with the *Sun*, the central powerhouse of our world, without whose light and heat life would be extinguished. The warmth from the sun in presence of necessary moisture starts the mechanism hidden in the dormant embryo which is the life centre of the seed, and provides the necessary temperature for the enzymes or digestive ferments in the embryo to function and to prepare the food stored in the endosperm or the seed storehouse. If the stored material is starch, it is broken down into various forms of simpler carbohydrate or saccharine material. If it should be oil, the oil is rendered digestible by the plant being converted into simpler bodies such as glycerine and so-called fatty acids. Through the energy developed in this way from the original reserve food supply present in the seed, the root system and the green leaf come into visible life. By the help of the sun the green plant begins to build itself up from the air and the roots draw sustenance from the food supply present in the soil. The green leaf for its proper functioning needs the alternation of light and darkness, since in the light it builds up carbohydrate from the moisture and carbon dioxide present in the air, giving out oxygen for the benefit of other living things, and in darkness it breathes out carbon dioxide by which species of combustion it obtains energy for its own growth and gives back carbon to other plants. Apart from the work of the sun's energy in facilitating these changes it is also the sun which provides the moisture necessary to life, since it is the sun which draws from the sea the water, which afterwards reaches the plant as rain, and which is stored behind the impounding dam, to reach the plant by way of the

irrigation canal. The need for balance even in the matter of sunlight is evident, when it is remembered that excessive heat causes the plant to wither and yet without any light or heat it also cannot live.

Balance of atmospheric factors

Air. The atmosphere of the earth, as we know, consists roughly of four parts of inert nitrogen and one part of life-giving oxygen together with traces of other gases, the chief of which is in the present relation carbon dioxide, a product of animal and vegetable respiration and of combustion of carbonaceous material. The oxygen is needed for the plant's own respiration and also for the maintenance of the necessary life in the soil on whose activity the root system and consequently the life of the plant depends. The nitrogen also enters the cycle through the cooperation of organisms, mainly specific soil bacteria, and also it may be through photo-chemical activity in the surface soil itself. Balance again in the case of the atmospheric factors in the life of the plant is essential. With too much air we have the conditions of a hurricane and the crop is beaten down and broken. If air supply is restricted by overcrowding, the healthy leaf respiration is impeded. Equally or even more than the leaves the root system needs air, and if the soil is clogged or water-logged so that a free supply of air to the roots is restricted, wilting and sapping of disease resistance sets in. This latter result is likely to be due to the upsetting of the normal life of the soil population resulting in the formation of toxic substances instead of the healthy production of carbon dioxide and of mineral end products such as nitrates which can be directly assimilated by the plant.

Proper use of water

Water has been seen as an essential element for plant life. Again if there is too much there will be flood and consequent deaeration of the soil resulting possibly in the formation of alkali soil. Too little water means drought. The proper utilization of water calls for the efforts of the engineer who builds reservoirs for the irrigation of vast areas. The right distribution of the water so stored calls more-over for the careful supervision of the engineer and the agriculturalist in combination. The geologist too has his field in pointing where underground water is likely to be found which could be lifted by the engineer by means of his tube-wells. The chemist here plays some part in determining the chemical nature of the available water. In the famous Report of Dr Voelcker, the foundation-stone of India's agricultural service, he mentions that in those days no analyses of irrigation water were available so that the saline content was unknown.

The plant's home

The *Soil* is the home and foothold of the plant. In this home are produced those elements of plant food which go to sustain the complicated life-processes exhibited by the plant itself. The physical structure of this home may first be considered, its texture whether loose and sandy or sticky and clayey, whether its reaction is acid or alkaline. Here is work for the chemist and physicist. The texture and aeration of the soil is naturally modified by the mechanical effect of ploughing. Here is the cooperation of man and animal or in the case of the tractor of man and the machine. There is evidence, however, which is brought out by Sir Albert Howard to indicate that the elimination of the animal in this operation may result in the breaking of the necessary cycle. The machine, while it opens up the soil and improves the air supply, returns nothing to replenish the plant food store diminished by the demands of the last crop. On the other hand it does supply power and it is a matter for consideration whether the increase of power afforded by the tractor can make up for the loss of fertilizer incurred by the absence of animals in agriculture. It is here that we have to consider the functions of the soil as a storehouse of plant food. It is possible to grow a plant on sand with the aid of purely chemical fertilizers. In this way the natural cycle is broken and the plant is maintained on drugs and stimulants supplied by alien hands. Under natural conditions a vast number of 'unseen helpers' combine to give the plant its natural food. These 'unseen helpers' dwell in the soil, provided

there is neither excess nor defect of moisture. First we may mention the tireless worm, nature's plough, turning and ever turning and masticating into a fine texture vast quantities of soil in the course of the year and more particularly maintaining the aeration of the soil. This is proved by an analogous activity in what is known as 'the contact bed' used in sewage purification which represents an intensive soil activity. If the aeration of these beds becomes defective vast numbers of worms rise in search of air showing that their presence in the depths of the soil was a certificate of satisfactory aeration. Again in the absence of adequate air the bacterial flora which oxidize ammonia ultimately into nitrate would cease to function. Besides the ploughing activities of the worm we have to consider the effect of deep rooting plants of different kinds in maintaining the proper aeration of the soil. Such growths as *Tephrosia candida* are often used on tea plantations and elsewhere as a natural plough to keep the soil texture open.

Plant food

Besides the organisms and the various growths necessary to maintain adequate aeration and consequently to permit of the other organisms to go about their lawful occasions, we have to consider the preparation of the plant food either in the soil or separately from the soil. If the raw material of the plant food is added to the soil without preparation, the energy of the soil kitchen, as it may be termed, will be largely given to the preparation of this food and the plant itself will have in consequence to wait for its nourishment. Ultimately it will need simple dishes containing the necessary elements of nitrogen, phosphorus, and potash, but as has been hinted above, if these are just given without the natural accompaniments healthy life will not result. After all a dinner of the digested products of protein may be suited for an invalid but not for a healthy working man. For the human organism to function properly it would seem that all its activities have to be brought into operation, and one part of the body cannot properly function unless in harmonious cooperation with others. So is the life of the soil. For the proper growth of the plant, therefore, there has to be cooperation between it and the varied life of the soil. This life includes bacteria of various kinds, those which fix nitrogen from the air, those which oxidize ammonia to nitrate, those which break down cellulose matter into humus and those which break down crude protein into its simpler constituents. Recent research has shown that the nitrogen-fixing organisms cannot do their work really satisfactorily when working alone, i.e. in what is called pure culture, but are much more active when working in collaboration with the other less well defined bacteria in the soil. Besides bacteria other organisms play their part. Algae of various types, these indeed in certain cases notably in swamp cultivation of rice, by living on the surface of the water bring oxygen down to the roots of the plants. Fungi take an active part in the breaking down of waste cellulosic matter as in the compost heap in which in accordance with the ancient practice of Chinese and Japanese farmers the waste material of forest and farm is broken down into plant food.

Another type of fungi are those which work in cooperation or symbiosis with the root system of plants. This is known as the mycorrhizal association and according to Howard this is essential for the healthy life of the plant.

Reserve Bank of the soil

All these activities are carried on mainly in the *humus* content of the soil. This vast storehouse results from the breaking down of waste vegetable material of all sorts. It may result from the normal processes of nature, from the decay of leaves in the forest, or of grass on the hillside, or it can be produced artificially by oxidation of waste animal or vegetable matter in the compost heap or the activated sludge tank. Humus may be said to envelop each granule of arable soil. It is indeed the Reserve Bank of the soil. If this reserve is depleted there is ultimate agricultural bankruptcy. It is necessary, therefore, to guard against too heavy overdrafts on this bank. When these are demanded over a prolonged period the result is disease as is shown in the 'dust bowls' of western America and the deserts of Mesopotamia.

Among all the agents contributing to the healthy environment of the plant, sun, air, water, living soil and plant food, we must not forget those other cooperators which visit the plant after it has attained maturity and help it to continue its existence, viz. the *insect*, particularly bees which bring pollen from one plant to another and so assist or interfere with the careful labours of the plant breeder.

In all the foregoing, to use the words of Sir Robert Robertson, quoted in a letter to the present writer, there is not merely a field but a perfect prairie of research, but enough is known to indicate very clearly the essentials for harmonious living among men. That is why this paper has been entitled: 'India's Millions and the Food Cycle'.

India's food supply

Of late years as the steadily mounting figures of the Indian census returns are scrutinized there is considerable apprehension as to whether the food supply can be proportionately increased. The foregoing presentation of the cooperation of living beings and natural forces which occurs under conditions of true social adjustment indicates that if this cooperation is forthcoming the fears for the future may be set at rest.

It may be remembered that competent authority has stated that under a scientifically controlled agriculture there is no reason why there should not always be boom crops, i.e. crops 50 per cent in excess of the average. The population of India has not yet increased in that proportion.

True scientific control means, as we have seen, not merely official supervision from a central office, but in addition something of poetic insight and sympathy. It was this, rather than formal laboratory and statistical training which enabled Luther Burbank to produce his marvels of plant creation.

Nothing is here implied of 'mysticism' or 'magic' such as has alarmed orthodox readers of some recent publications. On the contrary what is called for is close observation and free, unfettered and at the same time entirely rational, thinking.

It will be seen that for healthy life, whether of plant, animal or man, there must be cooperation. If at any point this cycle fails and there is a consequent undue accumulation, the disease, i.e. disharmony results. Thus in the absence of any one of the very numerous factors briefly indicated in the foregoing paragraphs there will be interference with the life cycle. As has been shown, the reservoir of plant food lies in the humus of the soil. On the title page of Waksman's treatise humus is defined as 'the product of living matter and the source of it', and it has been said that next to water humus is the most important source of wealth on this planet. And yet it would appear that rather than maintain this storehouse of wealth men fight and scramble for a useless metal which cannot be in itself of any serious value since it does not take any real part in the life cycle which has been described. Yet the superstition is that without an adequate amount of this useless metal labour is unable to function because no wages can be paid, and consequently life stops. It may be said that this metal can be exchanged into other more useful forms of wealth, e.g. houses, lands or luxuries. If, however, these forms of wealth accumulate in idle heaps at any point in the life cycle death will ultimately result. Essentially, it will be seen, life is *circulation*. Life is movement, and movement not of a portion but of the whole of the constituents of the living system—the soil, the air, and the water feeding the plant must be in movement. The soil must be from time to time stirred in order that the innumerable forms of life in the cooperative processes may function freely. Neither air nor water must be stagnant.

War and social unrest ultimately originate from an imperfect and inharmonious cycle which results in various forms of social injustice and exploitation. For a true solution of these insistent problems we may well take a lesson from the life of the plant and learn anew the inner truth of Tennyson's well-known little poem:

> Flower in the crannied wall,
> I pluck you out of the crannies;—
> Hold you here, root and all, in my hand.
> Little flower—but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.

THARPARKAR AND THARI CATTLE

By F. WARE, C.I.E., F.R.C.V.S., I.V.S.
Animal Husbandry Commissioner with the Government of India

THE large white cattle found in the semi-desert tracts of south-west Sind commonly known as Tharparkar cattle, have for a long time been systematically and carefully bred for milk production at a number of farms in different parts of India. The results of this work have shown that the Tharparkar possesses potentialities for milk production, combined with a hardiness of constitution which enables these animals to thrive in a variety of climatic and other environmental conditions met with in India. These results led the Imperial Council of Agricultural Research to accept the Tharparkar as a milch breed of all-India importance and to include these cattle among those chosen for central herdbook registration.

Steps were accordingly taken to have the breed characteristics of these cattle defined, and a small committee was set up for the purpose in 1937, but the findings of this committee did not meet with the approval of the Animal Breeding Committee and the Advisory Board of the Imperial Council of Agricultural Research, and another committee went into the question again two years ago. The report of the second committee met with much the same fate as that of the first, and the outcome of the prolonged discussions, which have taken place in the Animal Breeding Committee of the Council, is that included under the name of Tharparkar are two different types of animals.

One type, which it is proposed shall continue to be known by the name Tharparkar, has already been referred to in a previous paragraph, while the second is a smaller type of grey animal whose home is in the interior of the Thar desert. Tharparkar cattle are being maintained at the Government farms at Karnal, Patna and Kanke, while representatives of the Thari desert animal are to be found in the dairy herd at the Government farm at Sakrand in Sind.

In view of the controversial nature of the subject, the Advisory Board of the Imperial Council of Agricultural Research have decided that provisional descriptions of these two types should be published and this is accordingly now being done. It is hoped that this publication, by focussing attention on the subject, will, in due course, lead to a final solution of the question as to whether there is more than one pure breed to be found in the Tharparkar district and Thar desert of Sind, and if not what the characteristics of the genuine animal are.

The descriptions of Tharparkar and Thari cattle which follow have been taken from the reports of two committees of which Sir Arthur Olver, late Animal Husbandry Commissioner with the Government of India, and Khan Sahib A. M. Ulvi, Livestock Officer in Sind, respectively were the conveners.

Typical Tharparkar animal

The home of the Tharparkar breed is the arid, semi-desert tracts of south-west Sind. In this area the Tharparkar is bred pure in large numbers. They are also produced in the adjoining Indian states of Cutch, Jodhpur and Jaisalmer. This area consists largely of sand dunes and receives a low rainfall. The animals have therefore to subsist largely on desert grazing and bushes, and consequently they are hardy and strong.

Tharparkar cows are good milkers, and the bullocks are good workers of medium weight, useful for plough or carting. Owing to these qualities as well as their hardy constitution and ability to thrive on scanty fodder, Tharparkar cattle are now being bred at several Government farms away from their natural home, and they are proving very popular for the improvement of small local breeds in other parts of the country. Average lactation yields are 4,349 lb. in 286 days,

but yields as high as 9,655 lb. in 305 days have also been obtained.

General characteristics

The typical Tharparkar is a deep, stockily built animal of medium size and good quality with straight limbs and good feet. It has a strong well-proportioned frame with good bones and joints of fine quality. The horns are medium-sized and not noticeably heavy or long. The male gives a general impression of virility.

The colour of the skin is black, except on the udder, under the belly, on the lower part of the dewlap and inside the ears, where it is rich yellow. Hair is white or grey, with face and extremities of darker shade, and often a light grey stripe along the backbone.

Head

The head is medium in size.

Forehead : Protrudes slightly and is rounded above the eyes. The forehead is more prominent in the male than in the female and the whole head, neck and forequarters are stronger and more muscular.

Face and muzzle : Face is lean and fine, muzzle and nostrils broad and black. Lips are muscular and jaws strong.

Eyes : Full and placid.

Ears : Somewhat long, broad and slightly pendulous. A rich yellow colour of the skin inside the ear is preferred.

Horns : Curve gradually upwards and outwards in the same line as that of the poll with an even spread, moderately thick at the base, tapering gradually towards blunt points, and of medium length.

In the male the horns are thicker, shorter and straighter than in the female, and are inclined to turn backwards.

Body and limbs

Forequarters

Neck : Of medium length, clean cut and neatly joined to head and shoulders.

Dewlap : Loose and flexible but not voluminous, the skin is fine and mellow.

Chest : Deep and full between and just behind the forelegs. Breast is broad but not coarse or heavy in brisket.

Legs and shoulders : Shoulders are light, with a good distance through from point to point but thin at withers. Hump is moderately well developed in the male, but firm and placed in front of the withers. Legs are comparatively short but proportionate to size with strong knees and hocks and fine quality bone, ankles straight and strong, feet well rounded, medium in size, pasterns short, legs carried straight so as not to weave in walking.

Barrel

Back : Strong, straight and moderately long.

Ribs : Well sprung from the back and curving evenly with a large abdomen firmly held up.

Navel : There is a well-defined flap of skin at the navel corresponding to the sheath in the male, but it is not coarse or long. The sheath is of moderate length and not markedly pendulous.

Hindquarters

Loins and hips : Loins are broad and strong, flat from side to side and as near the level with the hip bones as possible. Hips are broad and quarters long and drooping slightly to the root of the tail.

Rump and pin-bones : Level and in line with back. Pin-bones well apart with good length from hook to pin-bones.

Flanks : Well let down and hollow in cows, not pendulous.

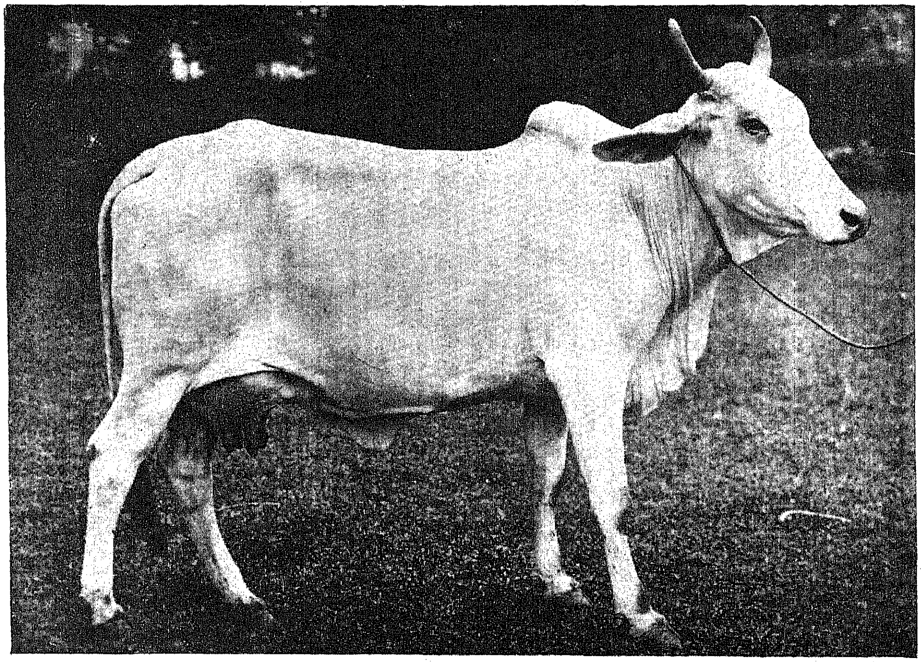
Thighs, buttocks and twist : Thighs are wide and fairly muscular but giving ample room for the udder and dropping straight from the pin-bones.

Tail : Thin and supple ; hanging loosely so that the end of the switch is 2 to 6 inches off ground. Switch is black.

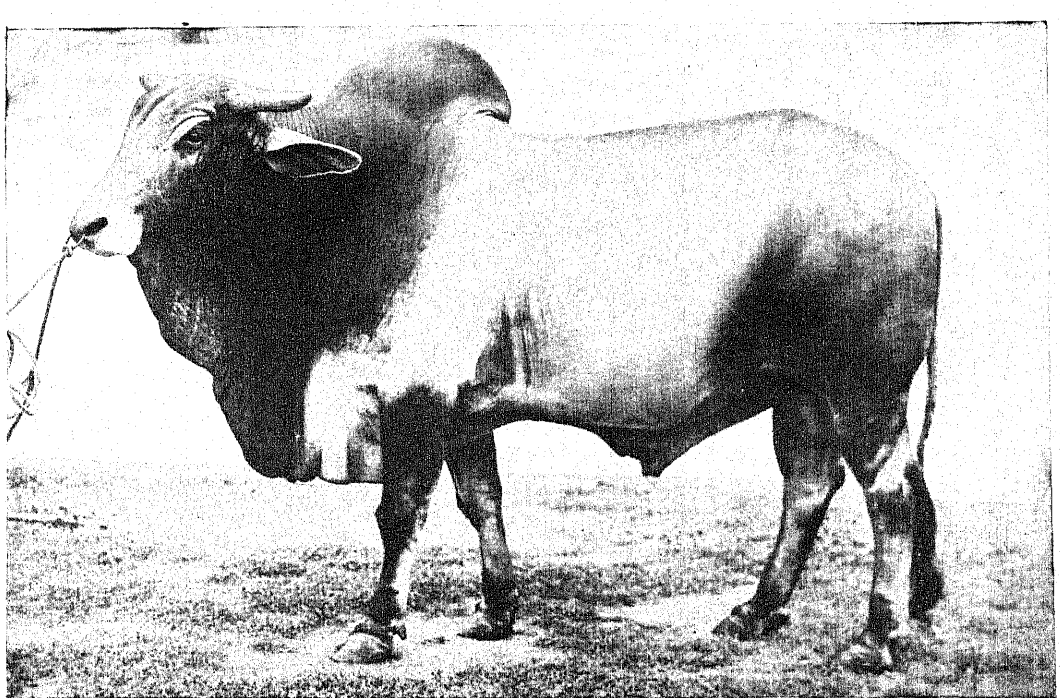
Hocks, legs and hoofs : Hocks well under body and set apart, legs with good bone, hoofs hard and black, moderate size, no tendency to turn out.

Udder, teats and milk veins

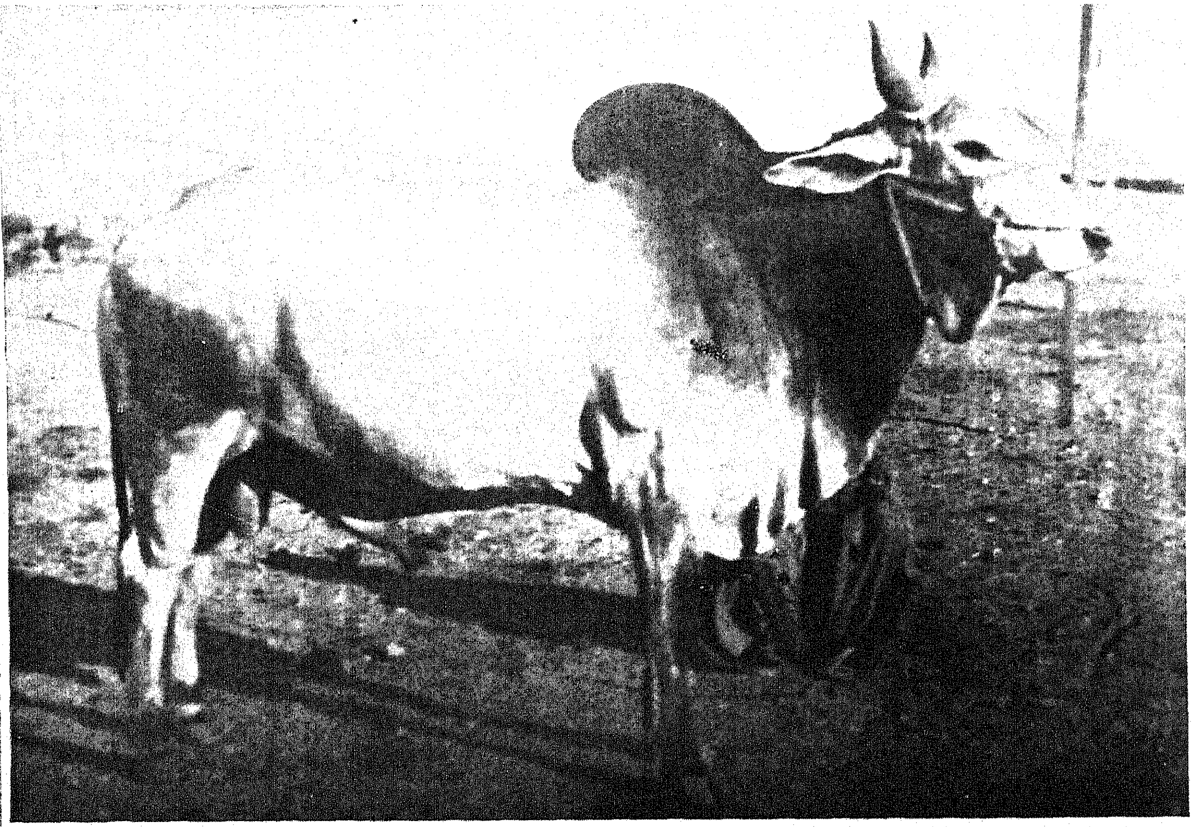
Udder is large and well developed in front and rear and is carried well up at the back. Floor of the udder is nearly level and not deeply cut up between quarters. The skin



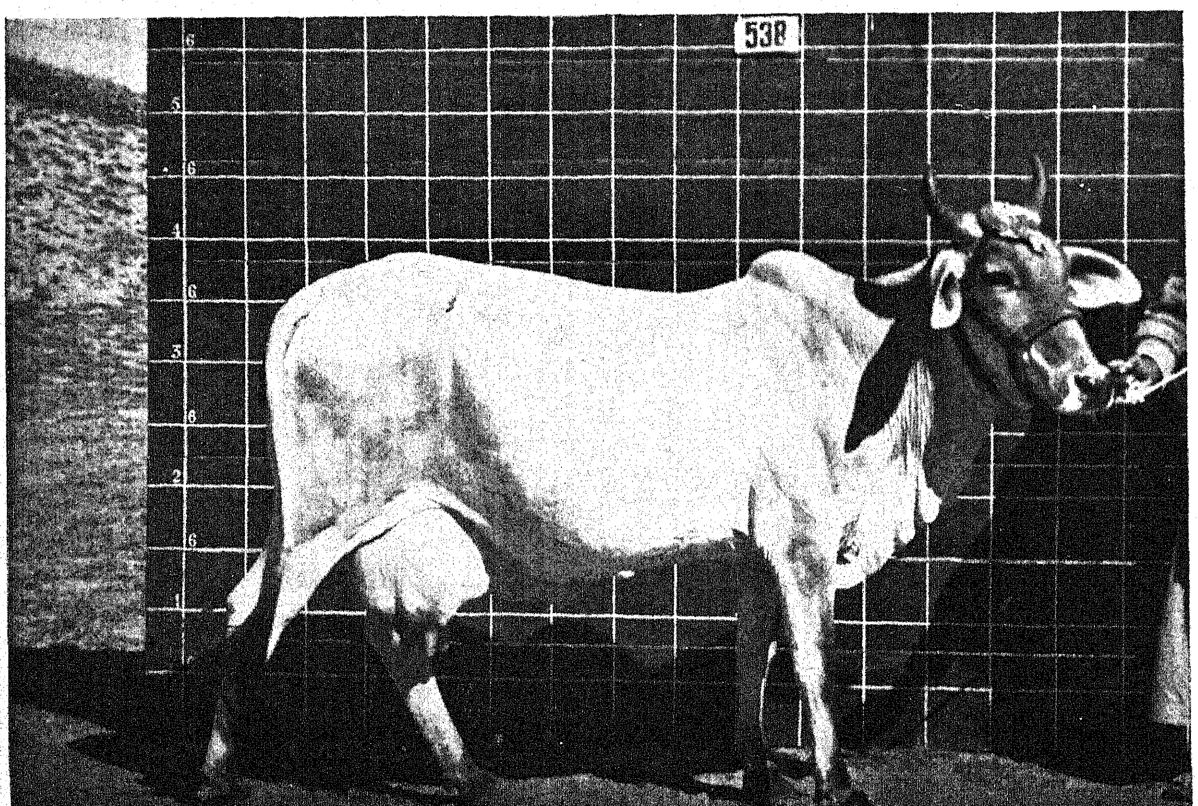
Tharparkar cow



Tharparkar bull



Thari bull



Thari cow

of the udder is fine and mellow with a yellow tinge and prominent veins. Teats are three to four inches long, uniform in thickness and set far apart at even distances.

Skin, hair and escutcheon

Skin is of fine quality, loose and mellow to touch. Hair is white or grey, fine, short and straight.

In the male, the hair is slightly curly on the forehead and of a lightish grey colour on the head, neck, hump and on the fore- and hind-quarters. On the rest of the body the hair is short, straight and light grey or white in colour.

Average measurements of typical Tharparkar animal

(In inches)

—	Male			Female		
	Max.	Min.	Average	Max.	Min.	Average
Height behind hump	53·0	48·5	51·4	52·5	49·0	50·9
Length from point of shoulder to pin-bone	64·0	58·0	62·2	60·0	56·0	57·6
Length of quarter from angles of hip to pin-bone	20·0	18·0	19·2	18·0	18·0	18·0
Height at angles of hip	53·0	48·0	51·2	50·0	48·5	49·6
Width between angles of hip	20·0	17·0	19·2	19·0	18·0	18·8
Height at pin-bone	49·0	47·0	48·1	46·5	45·0	45·9
Length of tail and height of end of switch from ground	41·0 and 10·0	39·0 and 6·0	39·8 and 8·2	39·1 and 10·0	32·0 and 1·0	35·8 and 6·6
Girth . .	67·0	62·0	64·2	71·0	69·0	70·0
Height at point of elbow	32·0	27·0	29·2	28·5	26·5	27·4
Measurement of bone below knee	9·5	8·5	8·9	7·5	7·0	7·3
Length of face from occipital crest to upper edge of muzzle	23·0	20·0	21·8	20·0	19·0	19·6
Width of face immediately above eyes	10·0	9·0	9·4	9·0	8·0	8·5
Length of lower surface of ear measured from tip to junction of ear to face	14·0	11·0	12·4	12·0	10·5	11·2

Typical Thari animal

The home of the Thari breed is the Thar desert region, which is a vast, sparsely populated area measuring about 8,000 sq. miles. This area consists largely of sand dunes running parallel from south-west to north-east and is bounded on the south by the Rann or treeless desert of Cutch, on the east by the Marwar State, on the south-east by Palanpur Agency and on the west by the alluvial plain of Sind. The height of the dunes or *bhits* ranges from 50 ft. to 300 ft. The villages, consisting of a few huts, are far apart and are built round a *tarr* or well.

The rainfall is limited to about 10 inches a year and is very irregular and the depressions between the *bhits* act as catchment areas and are cultivated with quick-growing millets like *bajri*, pulses like *guara*, etc.

The sand dunes are covered with brushwood and types of mimosa and also permanent bushes, and during a season of good rain grasses spring up profusely. The limiting factor for cattle-breeding is the number of wells which are far apart as well as deep. The depth is 100 to 200 ft. and water is lifted by leather buckets drawn by a pair of camels, cattle or four to six donkeys.

The cattle remain loose in the jungle throughout the 24 hours, coming back only once a day in the morning to the well for watering purposes and for milking the cows.

Stall-feeding is not the practice, but in big villages and towns during dry weather milch cows are helped with a little *guara*, *bajri* and a small ration of steeped or boiled *guara* seeds. It will be seen therefore that for animals to thrive under such conditions they must have : (1) great power of endurance and resistance to famine and drought, and (2) ability to cover long distances under desert conditions, hence grace and ease of carriage.

The cows are good milkers and the bullocks are good workers of medium weight and useful for both plough and carting. The average lactation of milking cows under desert conditions is estimated to be 3,000 lb. and when taken to the plains under conditions of stall-feeding and rearing the animals yield much larger quantities.

General characteristics

The animal is strongly built, of medium size with an alert and springy carriage. The head is carried high and well and the whole body suggests poise, balance and 'quickness off the mark'. On the whole there is a general appearance of 'breeding'.

The horns are not heavy or long and there is no excess of flesh in the dewlap or along the belly. The *bedami* or protuberance of the frontal bone between the horns, if present, is only slightly marked.

The colour is generally grey or white. In some cases, specially the darker animals, a lighter grey stripe running from the hump to the tail is present. The colour of the castrated animal usually changes from grey to white. Patches of red are not liked.

Head

The head is of medium size.

Forehead: Broad and flat and the roots of the horns are set wide apart. The front of horns and face are practically in one plane. The skin between eyes is often wrinkled, the wrinkles running perpendicularly. The nasal bone is not wide but long and sloping on both sides.

Face and muzzle: Medium-sized and black, tapering, and sometimes slightly dished.

Eyes: The eyes are intelligent and full.

Ears: The ears are fairly long, broad and semi-pendulous.

Horns: They are set wide apart and curve gradually outwards and upwards with the points somewhat turned in. In the male the horns are thicker, shorter and straighter than in the female.

Body and limbs

FOREQUARTERS

Neck: Of medium length, clean-cut and neatly joined to the head and shoulders. Hump is well developed but not hanging.

Dewlap: Spare, medium size and fine.

Chest: Chest and brisket of medium breadth and size.

Legs and shoulders: Legs are proportionate to the body and the bone is of fine quality. Feet are medium-sized and the hoofs look capable of standing hard work. In the male, the legs are specially muscular with strong bones. Shoulders are light.

BARREL

Back: Proportionately long and straight and in some cases slightly dished behind the hump.

Ribs: Well sprung from the back curving evenly with the abdomen firmly held up.

Navel flap: Generally present in the female. In the male the sheath is semi-pendulous and moderately long.

HINDQUARTERS

Loins and hips: Loins are broad, flat and level with backbone. Hips are wide and croup fairly long and straight.

Rump and pin-bones: Rump fairly straight and in line with the backbone. The pin-bones are widely placed.

Flanks: Well marked in the cow.

Thighs, buttocks and twist: Hind legs are strong and straight with no lumpiness in the thigh. Thighs are broad and straight, giving ample space for udder; tail is highly placed, and is long and fine reaching below the hock with a long black switch ending 2 to 4 in. above the ground.

Hocks: Well set apart with no tendency to weave in walking.

Udder, teats and milk veins

Udder: Capacious, level, and not pendulous. The skin of the udder is fine, with short soft hair. The bottom line of the udder is remarkably straight for an Indian cow.

Teats: 2 to 4 in. long, and squarely placed.

Milk veins: Prominent.

Skin, hair and escutcheon

The skin as a rule is fine, mellow, loose and soft to touch, with soft hair varying from white to dark grey in colour. The skin is black all over the body with the exception of inside of the ears, udder and under the tail, where the colour is pink or yellow. In the male the hair is slightly curly on the forehead and the colour dark grey on the head, neck, hump, fore- and hind-quarters. The rest of the body is grey, silver grey or white.

Average measurements of typical Thari animal

(In inches)

—	Male Max.	Male Min.	Male Average	Female Max.	Female Min.	Female Average	—	Male Max.	Male Min.	Male Average.	Female Max.	Female Min.	Female Average.
Height behind hump	51·5	48	49·6	51	44	47	Girth . .	75	64	65·6	72	56	62
Length from point of shoulder to pin-bone	61	52	57	57	48	53·8	Height at point of elbow	30	26	27	29	24	25·8
Length of quarter from angles of hip to pin-bone	19	16	17·1	17·5	15	16·2	Measurement of bone below knee	8	6	7	7·5	5	6·1
Height at angle of hip	52	46	49·9	51·5	44·5	46·7	Length of face from occipital crest to upper edge of muzzle	20·5	18	19·2	19·5	16	17·9
Width between angles of hip	18	14	16·4	19	14	15·9	Width of face immediately above eyes	11	9·5	10·3	9	7·5	8·3
Height at pin-bone	48	42	44·7	48	39	43	Length of lower surface of ear measured from tip to junction of ear to face	12·5	9	11	14	10	11·7
Length of tail and height of end of switch from ground	49·5 and 6·5	39 and ½	45·5 and 2·5	49·5 and 8·5	35 and ½	42·2 and 2·8							

STORAGE OF POTATOES*

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THE problem of providing proper and adequate storage facilities is particularly important in the case of potatoes, which are of semi-perishable nature. Although the seasons of harvesting in different parts of India overlap to some extent, there remain considerable gaps and it is, therefore, necessary to store potatoes to meet the demand in the off-season.

The two main practical problems to be faced in regard to storage are the extent of the price premium and the method of storage.

Price premium

The seasonal rise in the price of potatoes is a well-known tendency. During February and March they sell at Re. 1-8 to Rs. 2-8 per maund, but from July to November prices go up and are nearly double what they are in the previous period. The rise in the price of seed potatoes is even higher. At the time of harvest their prices range from about Re. 1-8 to Rs. 2-8 per maund but after about six months prices go up in most of the markets, particularly in the United Provinces, Bengal, Bihar and the Punjab to Rs. 5 to Rs. 14 per maund. In spite of such high prices, however, those who store potatoes do not profit very much as more than 50 per cent of the potatoes are generally lost during storage. If this loss could be reduced prices would not rise so steeply, producers would obtain seed at a cheaper rate and cost of production, generally, would be reduced.

Methods of storage and costs

In the plains the produce of the winter crop is generally stored as it keeps better. The methods of storage practised in different parts of the country vary considerably. In Bihar edible potatoes are not usually stored for any length of time. For seed purposes, however, potatoes are stored in large quantities for a period of five to six months during March to October. They are stored in sand where they keep better and are protected to some extent from the potato moth (*Phthorimea operculella*), which ordinarily does considerable damage during the storage period. The godowns used for storage are built on a higher plinth and are usually surrounded by other buildings to keep them cool. Before storing, potatoes are kept in the open for some time so that surface moisture may dry up. During this period the diseased and damaged tubers are removed. Potatoes are stored 9 in. to 12 in. deep between two layers of sand each 1 in. thick. Care is taken to cover all tubers. A week after storing the tubers are examined. If it is found that heat has developed the potatoes are taken out and left in the open for a couple of days. The damaged tubers are removed and the others are again covered with sand. If, however, temperature in the heap is normal it is opened after a fortnight for taking out the damaged tubers. In the monsoon season, however, potatoes are taken out more frequently for sorting out bad ones and for breaking off the sprouts, if any. After the monsoon, only sound tubers are preserved in baskets arranged on a *machan* (platform made of bamboo). While in baskets potatoes are examined now and then for taking out bad tubers and breaking off the sprouts.

In the United Provinces the method of

* Condensed from Chapter VII of the *Report on the Marketing of Potatoes in India and Burma* (1941).

storage is more or less the same as that followed in Bihar. In the hills, however, potatoes are sometimes stored for seed purposes by burying them in pits dug for the purpose.

Methods vary in Bombay

In Bombay, the methods of storage differ considerably from place to place. In Poona, which is the most important district for potato cultivation in the province, potatoes are generally stored in pits dug out in the fields 18 in. deep and 2 to 3 ft. wide. The length of the pit depends on the volume of the produce to be stored. The pit is filled with water which is allowed to soak for five days. When it is dry, *neem* (*Azadirachta indica*) leaves are spread out at the bottom and the sides to avoid the tubers coming into direct contact with the soil. Selected tubers, which have been previously dried, are heaped in the pit usually up to a height of 3 to 3½ ft. and are covered with a thick layer of grass or *kadbi* (*jowar* stalks). A ditch is then dug round the heap at a distance of one to two feet which is occasionally filled with water. Sometimes when it is very hot, water is sprinkled on the top of the pit to bring down the temperature. As far as possible, the pit is not disturbed until the potatoes are finally taken out for sale. The potatoes are inspected occasionally by opening the top covering and picking out a few tubers. If the potatoes are found to have been attacked by moths, they are disposed of as quickly as possible. To check the attack of moths, some cultivators fumigate their produce with petrol, particularly if it is to be stored for seed purposes. In a number of villages, permanent fumigation chambers have been constructed and are in charge of village committees. They are built of bricks and are lined with cement plasters to make them air-tight. They are cylindrical in shape with an internal diameter of 7 ft. and a depth of 6 ft. and have a capacity of 2½ tons of potatoes packed in bags. To get rid of the moth completely a second fumigation is necessary after about 10 days by which time the eggs of the moth are hatched out.

Improved method in C. P.

In the Central Provinces very small quantities of potatoes are stored on account of the greater liability to attack by the potato moth. The local Department of Agriculture has, however, recently introduced an improved method of storage which is being gradually adopted by growers. In principle this method is the same as that followed in Poona. In the Central Provinces, however, the pits are dug 24 in. to 30 in. deep and potatoes are heaped to 6 in. below the neck of the pit. Another important difference is that in the Central Provinces bamboo shafts are used for ventilation. Potatoes kept in pits sweat due to the process of transpiration and respiration and the moisture thus accumulated causes rotting. To have free aeration in the pits pieces of hollow bamboo with the septa at the nodes removed and having holes in the sides are used to serve as chimneys or ventilators. The chief merit of this method consists in the bamboo chimney which considerably reduces the temperature during the hot months by allowing proper ventilation in the pits.

The estimated cost of storing potatoes in the case of the method practised in Bihar varies from 6 to 7 pies per maund per month. In places where the pitting processes are followed, as in Poona and the Central Provinces, the cost per maund per month works out at about 1 anna. Thus it will be seen that the cost of storage is negligible when compared with the rise in prices as the season advances. But the losses during storage are heavy.

Loss in storage

The loss in storage depends on a number of factors, the most important being temperature, humidity, aeration, soundness of tubers and their freedom from earth and moisture. About 36°F is a suitable temperature for storing potatoes, but during summer the temperature in the plains is very much higher, resulting in enormous losses. In certain cases it is almost impossible to preserve the seed potatoes of one season till the next. Proper humidity is also of great importance, but under the existing conditions of storage it is not possible to control humidity. Damage resulting from insufficient aeration is caused by lack of oxygen. Adequate provision should, therefore,

be made for ventilation. One of the important causes of rotting is the storage of unsound tubers which may be either mechanically injured or diseased. Germs of diseases and the insect pests inhabiting the store-room immediately attack the unsound tubers and subsequently the sound ones also. It is a common practice to harvest the crop when the soil is somewhat moist. A certain amount of soil, therefore, remains sticking to the tubers. When potatoes are stored wet with large quantities of soil adhering to them they develop considerable heat, especially if stored in bulk, and rot rapidly. Potatoes intended for table purposes are damaged by exposure to light while the quality of seed potatoes is not adversely affected.

The annual loss in storage is heavy in India because scientific methods are not adopted. The annual losses in storage and in the process of marketing amount, at a very conservative estimate, to about $8\frac{1}{2}$ million maunds valued at Rs. 1 crore 66 lakhs. The loss in storage can be reduced in two ways: firstly by improving the existing methods, and secondly by storing potatoes in cold stores.

Hints on storing potatoes

The following hints on storing potatoes may be of some use:

(1) Well-ripened tubers should be selected.

(2) Before storing tubers should be dried and cleaned of dirt.

(3) All diseased, bruised and cut tubers should be removed and only clean and sound tubers should be selected for storage.

(4) The store-room should be situated in a dry and cold place, preferably under the shade of a tree or surrounded by other buildings. Underground cellars have a low temperature and are well suited provided they are not damp. The floor should be plastered or cemented and should be absolutely dry. The rooms should be well ventilated and all doors and ventilators should have wire-gauze of fine mesh to prevent the entry of potato moth, etc. There should be no cracks and crevices in the walls where insects might take shelter.

(5) The store-room should, if possible, be fumigated with sulphur fumes.

(6) The ventilators of the store should be opened every morning and evening but should be closed during the day.

(7) Potatoes should be stored in dry sand as far as possible as it protects them from the attack of moth and keeps them cool. If they are not kept in dry sand they should be fumigated with petrol.

(8) Potatoes should not be piled in layers of more than 9 in. to 12 in. deep.

(9) Potatoes should be inspected periodically and rotten and diseased tubers removed.

Cold storage

The conditions of storage of potatoes in summer months in India are far from satisfactory. The main problem is to protect them from high temperature in the summer months. This can be done by keeping potatoes in cold storage. Till recently, however, cold storage facilities have not generally been availed of for storing potatoes. There are several reasons for this apathy. First, people have not yet realized the advantages of cold storage and few have seriously thought of utilizing the cold stores for storing a cheap and semi-perishable commodity like the potato. Secondly, the port towns where the cold stores are mostly located are at long distances from the main producing centres, and the cost of transport to the cold store including the rent for storage has been rather high.

The importance of cold storage for potatoes is, however, being realized gradually and in recent years cold stores have been erected in certain important producing centres like Meerut, Sialkot, Patna and Jammu. The results obtained so far indicate good prospects for the development of cold storage in respect of potatoes. For instance, the quantity of potatoes stored in the Meerut cold store increased from 3,000 maunds in 1938 to 12,000 maunds during the following year. The results achieved in these two years have been so encouraging that the proprietor had under consideration a scheme to enlarge the cold store.

Seed and table potatoes

The problems of storing potatoes for seed and table purposes have to be considered separately. The prices of table potatoes in most of the markets are low from January to May and high from June to November, the

differences in certain cases being as high as Rs. 2 per maund. Taking the cost of cold storage at 4 annas per maund per month and the average period of storage at two months, the cost of storing plus other incidental charges would come to about 12 annas per maund. After meeting all expenses, therefore, there still remains a margin of more than a rupee per maund.

Potatoes kept at low temperature for a considerable period accumulate sugar and taste sweet when cooked. If, however, they are afterwards exposed to ordinary temperature, for a week, most of the accumulated sugar changes into starch and they no longer taste sweet.

Potatoes for seed purposes have to be preserved for six to seven months and losses in this case are enormous under present conditions. There is, therefore, a vast difference in the prices of these potatoes at harvest time and at planting time, ranging from Rs. 2 to Rs. 9-9 per maund. This clearly indicates the possibility of using cold stores for seed potatoes even if storage charges are over 4 annas per maund per month.

I C A R work

Under the cold storage scheme at Poona financed by the Imperial Council of Agricultural Research, considerable work has been done on the effect of storage temperature, on germinating capacity and the chemical changes that take place during storage. It has been found that freshly harvested potatoes can be preserved without sprouting for three or four months at 52°F, for five months at 45°F, for seven months at 40°F, and for an almost indefinite period at 35°F. It was also observed that potatoes remained dormant for seven months at 40°F when stored soon after harvest, whereas those obtained from the same source but stored after exposure to ordinary temperature for two months began to sprout after two months.

If tubers are properly selected, the wastage due to rotting at about 35°F and 40°F is almost nil. The loss in weight in storage during nine months at 35°F is about 10 per cent when potatoes are kept in open trays, and about 5 per cent if kept in gunny bags or crates at 40°F. The germinating power of potatoes is not affected by cold storage at 35°F even for a year.

According to experiments and observations made by the commercial concerns, the loss in cold storage in 5 to 6 months may be taken to be 2 to 6 per cent, which is very small when compared with losses sustained by other methods.

THE YOUNG FARMERS' CLUB

By S. M. Huda, B.A. (Pat.), Dip. Rur. Econ. (Oxon.)
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In the U. S. A., Great Britain, Sweden, and other European countries, Young Farmers' Clubs are spreading rapidly and have already met with a fair amount of success. They enable rural youth to acquire some knowledge of the principles of scientific farming which is a logical foundation for the practice of better farming. It is not claimed that it is better than the organized educational system, or that the knowledge that a young farmer derives from a club is equal to the knowledge acquired in a properly organized course of education. Nothing would be better than organized courses established throughout the country on a firm basis; but in the absence of such organized courses, Young Farmers' Clubs should go a good way to meet the present need.

Further, things are learnt in the club which are not generally acquired in the systematic class and there are three points very attractive in a club which must be mentioned. Firstly, the club is self-governing, which should develop qualities required for national self-government. Secondly, the educational aspect of the work is not of the traditional type and it does not require mere mental absorption of facts about farming. Thirdly, the club also develops personality and character and thus teaches young farmers to be effective members of the community.

Bridging the gap

A great deal of scientific work has been accomplished on Government experimental farms in India, but very little has been done to convey the ideas to our farming community, and it must be admitted that our present problem is to carry to the field the results of laboratory research. I am sure such an organization as the Young Farmers' Club can meet our present need. Further, if interest is created among children, it will have great influence on their parents.

Young Farmers' Clubs first grew up in the U. S. A., but the idea was not slavishly followed in Great Britain and Sweden. Every country has its own problems and it will be unwise to follow an idea blindly without regard to the country's need. Even in a country like England there is a great difference between different clubs and we should expect considerable difference between the organization and policy of European countries and of India. However, we can always learn by picking up new ideas and criticizing old ones. Again, it must be emphasized that no one wants a cut and dried system which must be adhered to. For the healthy development of the club organization, free scope is required. The organization of the Young Farmers' Club in Great Britain and Sweden is described here and readers can consider how best they can organize such clubs in their own locality or village.

Organization of the club

The Young Farmers' Club movement was first started in England in 1921, and by 1939 there were 200 clubs with 4,000 members. It is open to boys between 10 and 21 years of age. The club has a chairman, a secretary and a treasurer, who are elected. Members are required to look after the stock or the plot with which they are provided and to keep careful and accurate accounts of the feeding and general management of stock. The work is carried on on strict business principles and after the sale of the stock or the crop members share the profit. Deductions have to be made for the cost of stock or implements and the cost of maintenance. Members attend meetings of the club and the business of meetings is arranged in such a manner that members gain experience in the management of affairs which should prove useful when they grow up. In all clubs great importance is given to record books and members are expected to bring

their record books at each meeting and compare notes with one another.

The club is assisted by a club leader who belongs to the club but is not a member. He is a 'guide, philosopher and friend'. He gives them help and encouragement. He is a very important part of the club and the success of the club depends to a large extent on its club leader. Great care is taken in the choice of a leader. He is expected to have a real interest in the club and must have knowledge of the type of stock and crop-raising carried on by the club. He supervises the works of the club officers and helps in keeping records. The leader is helped by an advisory committee which consists of local farmers and landowners. They offer advice about the proper housing, feeding and care of animals or about general lines of cultivation. The committee looks after the purchase and distribution of stock or equipment and arranges for its periodic sale.

Financial arrangements

Finance is a difficult problem, and money is needed to purchase stocks or implements. A loan could be taken directly from persons interested in the club or on their guarantee to a bank to provide the necessary overdraft. The money is repaid when the stock is sold at the end of the season. There are some clubs which allow members to supply their own stock, but such stock has to be inspected by the advisory committee. Members contribute to the club fund by means of a small subscription and the clubs are able to build up a fund for themselves. Meetings of the club are held monthly or fortnightly. In addition to the usual discussions, lectures are given by agricultural officers or teachers or by efficient local farmers.

I have included Sweden in this article because the club in Sweden is an all-round educational movement for farmers' sons and daughters. The Jordbrukare Ungdomen Forbund, which might be translated 'Farming Youth Club' works along certain lines. It takes social care of rural young people, their education and undertakes all-round free and voluntary educational work among the adult youth to foster technical training, good citizenship and personality. Each club is expected to carry on along three lines: (1) crop-growing, (2) stock-raising, and (3) domestic work. While in Great Britain stock-raising is very popular, in Sweden, members have to take to crop-growing for a year before they take to the rearing of stock. The idea is that the growing of crops is the basis on which animal husbandry is built up.

Government assistance

The organization in Sweden is to a large extent a Government organization, but in Great Britain it is primarily voluntary. However, the Government in Great Britain has always encouraged the movement and has given continued financial assistance. At a time when there is a demand for rural reconstruction and farming reorganization, it is necessary to draw the attention of the educated class and the Government to an organization which has progressed rapidly in western countries and which I am sure, will be able to do immense service in the uplift of the rural community in India. The machinery of the Young Farmers' Club has been described, but like other things it requires the spirit to make it work. If the right lead is given by the Government and the intelligentsia, that spirit will not be lacking among our rural population.

INDIAN SUGAR DURING THE LAST DECADE

By M. P. Gandhi, M.A., F.R.Econ. S., F.S.S.

THERE is fairly conclusive evidence to prove that India is the accredited birthplace of sugarcane, as indeed also of cotton. Little attention was paid, however, to this industry until after the World War, when the desirability of utilizing the sugar resources was examined without any tangible result by the Government of India. The Sugar Committee appointed in 1920 laid great stress on the importance of sugar in the national economy of India, and subsequently the Imperial Council of Agricultural Research, established in 1929, drew the attention of the Government of India to the necessity of the establishment of this industry in India. This Council deserves great credit for the establishment of the modern sugar industry and its development to its present stage.

Tariff protection

An important landmark in the history of the sugar industry was the year 1930-31 when a Tariff Board was appointed to consider the question of protection. The development of this industry since the grant of adequate tariff protection to it, commencing from April 1932, and the assurance by the Government of India to maintain it for a period of 15 years has been magnificent. Indeed, it is true to state that the industry has been revolutionized as a result of liberal protection.

From being a country which was mainly dependent on foreign sources of supply up to 1931-32, India has now become the largest sugar-producing country in the world, with an output far in excess of its present estimated annual requirements, and with a potential capacity (with its present equipment of factories) under normal conditions of working for production of about 1½ million tons of white sugar, i.e. roughly 1½ times the quantity annually required for internal consumption at the present time.

Imports eliminated

As a result of the rapid development of this industry, the import of sugar estimated at about 900,000 tons in 1929-30 and valued at about Rs. 160 millions has now practically disappeared and the country has been rendered absolutely independent of any foreign sources for the supply of sugar.

The number of factories has increased from 32 in 1931-32 to 147 in 1940-41, the production of factory sugar has gone up from 158,000 tons in 1931-32 to over 1,200,000 tons in 1939-40, and over 875,000 tons in 1940-41, while the import has fallen from over 400,000 tons in 1931-32 to about 35,000 tons in 1940-41.

It was in 1936-37 that the total production of sugar in India exceeded for the first time its estimated consumption and there was a large carry-over of sugar estimated at over 200,000 tons to the subsequent season. Since then, as a result of the decline in the area under cane and the poor cane crop, the production of sugar fell considerably and about 300,000 tons of sugar had to be imported in 1938-39 to make up the deficiency. During 1939-40, however, as a result of a large cane crop, the total production of sugar was about 1,373,000 tons. But there was a large carry-over of about 400,000 tons at the commencement of the 1940-41 season, the highest in the history of the industry, and from the present situation it appears that even this will be exceeded at the commencement of the 1941-42 season.

Superior quality

It must be observed that India now produces a superior quality and higher grades of sugar equal to Java sugar which are suitable for export. Proper planning can ensure the supply of the stipulated quantity from year to year, which can be safely depended upon by any country with which arrangements are made.

It is not generally realized that at the present time India has about the largest area under cane cultivation in the world. From a total area of about 3 million acres under cane cultivation in 1930-31 there has been a considerable expansion in acreage, the maximum being in 1936-37 when it exceeded 4½ million acres. The estimated area for 1940-41 is 4,215,000 acres as compared with 3,705,000 acres in 1939-40. Concurrently with the expansion of cultivation there has been witnessed an equally marked improvement in the quality of the cane. The acreage under improved varieties of cane increased from 817,000 acres in 1930-31 to about 3,452,000 acres in 1936-37. The average cane production per acre has also increased from 12·3 to 15·6 tons, but yet it is remarkably small as compared with other countries like Java and admits of considerable improvement by comprehensive research.

Gur *industry*

No picture of the sugar industry would be complete without a reference to the importance of *gur* manufacture which consumes about four times the quantity of cane consumed by white sugar factories annually, approximating to about 65 per cent of the annual cane crop. The calculated net production of *gur*, which is an article of direct consumption, has been varying between 2,700,000 tons and 4,200,000 tons during the last few years as compared with the production of sugar varying between 600,000 tons and 1,300,000 tons. The *per capita* consumption of *gur* is roughly 20 lb. while that of sugar varies between 6 to 7·5 lb. *Gur* is not only used as a sweetening ingredient in food and drink but is a wholesome article of diet. Almost all the *gur* produced in one year passes into consumption in the same year and there is neither export nor carry-over for the next season.

With an improvement in the general standard of living and the gradual industrialization of the country, there has been some increase in the consumption of sugar, but it cannot be said that it has been at the expense of *gur*.

It would be of interest to compare the figures of the *per capita* sugar consumption for the crop year 1 September 1938 to 31 August 1939, in the important countries of the world from the following table:

Per capita consumption of sugar

	lb.
U. S.	103
U. K.	112
Java	11
Denmark	128
Egypt	20
Japan	29
Australia	114
New Zealand	115
India	23 (including *gur*)

It will be seen that there is great room for improvement in the sugar consumption in the country but it depends to a large extent upon the price at which sugar and *gur* are made available to the masses, and the increase in the purchasing power of the people as a result of prosperous economic conditions.

It is interesting to note that the most important sugar-producing regions in India are sub-tropical, comprising the United Provinces and Bihar where the industry is chiefly concentrated and which are responsible for about 64 per cent of the total acreage under cane, and for the production of about 75 per cent of the total sugar produced in the country.

Improvement in efficiency

There has been an improvement in the efficiency of extraction of Indian factories since the Sugar Committee reported in 1920. At that time the average recovery was 6·25 per cent which has now improved to about 9·5 per cent. The Indian industry is thus improving its efficiency, and with a progressive improvement in the quality of cane which largely influences the recovery of sugar, the rate of recovery will show a further improvement. The maximum recovery obtained in any factory in India has been 12·25 which compares very favourably with the average recovery in Java.

One or two interesting features of the industry in India which may well be commented upon here are: (1) the industry in India is a seasonal industry, the cane factories working for about four to five months in the year, between November and April It is only in one part of the country, viz. Mysore

in southern India, that the industry is working for a period of nine months during the year. (2) Unlike Java, where factories cultivate cane on their own land or land under their control, the cane cultivation in India is almost entirely outside the control of factories, which purchase their cane from ryots having small holdings of land and are therefore not in a position to arrange for harvesting when cane has reached maturity and is in the optimum condition. This is a serious handicap all over India except in the Bombay Presidency where factories grow their own cane. But with adequate research and cooperation with cultivators, this handicap should be minimized. The ultimate prosperity of the industry hinges on the availability of cheap, disease-free cane of the requisite quality and high sucrose content.

Development of power-alcohol

The United Provinces Government have enacted legislation this year for permitting manufacture of power-alcohol for compulsory admixture with petrol with a view to utilizing the surplus molasses of factories, and to enabling the development of a new industry. It is expected that power-alcohol will be manufactured in the United Provinces from 1941. The credit for being the pioneer in this respect goes to Mysore, which has been producing alcohol for over three years now.

The development of the sugar industry during the last decade has been romantic, but it would not do to rest on past laurels. Efforts must be continued to improve its efficiency further by reduction of price of cane which would be possible if the total tonnage per acre is increased and the quality of cane improved, and by decreasing the cost of manufacture by increasing the length of the cane-crushing season by the growth of early and late-ripening varieties, by the utilization of by-products like molasses and bagasse and by increase in recovery of sucrose. It is absolutely essential to decrease the price of sugar with a view to increasing the consumption of sugar in the country and export the surplus production to neighbouring countries like Afghanistan, Tibet, Nepal, Burma, Ceylon and also to the United Kingdom, and other foreign countries, to such extent as is possible.

Second largest national industry

To summarize, the sugar industry in India is the second largest national industry of the country. It represents an investment of indigenous capital to the extent of Rs. 32,00,00,000. It finds employment for about 3,000 graduates in science, engineering, commerce and arts, and for about 125,000 unskilled labourers. It has enabled the country to stop the annual drain of money approximating to Rs. 16,00,00,000 to foreign countries by producing sugar within the country itself, and by eliminating imports altogether. The interests of no less than 20 million cultivators are intimately connected with it. The amount of money paid to cane-growers by the factories alone has been increased from about Rs. 1,77,50,000 in 1931-32 to Rs. 15,00,00,000 in 1939-40. The income of the cane cultivators has been augmented considerably by the improvement of the sugarcane crop on account of the comprehensive research undertaken at various places by the Imperial Council of Agricultural Research, and this increase in their income has been assessed at about Rs. 2,50,00,000 per year.

Transport agencies like railways, motor buses and village carts have also derived large benefits from it. The consumers have benefited due to the availability of sugar at rates cheaper as compared with the pre-protection period, except in the last two years due to the high price of cane and shortage of production of sugar. But this feature cannot be permanent and the consumer may again look forward to an era of cheap sugar with effect from the 1941-42 season.

Further, this industry has been responsible for the development of the village industry of *gur* manufacture.

An idea of the importance of the sugar industry can be had when it is remembered that the value of the production of *gur* and sugar works out roughly to about Rs. 75,00,00,000 per year.

The progress and prosperity of such a great national industry which has rendered India independent of outside sources for such a valuable nutritive article, which has benefited all interests concerned and which is a valuable

asset in the agricultural as well as industrial economy of the country, should continue to receive sympathetic attention from her industrialists, labour-leaders, agriculturists, legislators, politicians, as also of the Governments both provincial and central.

It is hoped that the Central Advisory Council, whose establishment was recently announced by the Hon'ble Commerce Member, will help in the solution of the various complex problems now facing the industry, e.g. of overproduction, of internal provincial competition, of regulation and of nationalization of the industry.

A POLE FOR CARRYING HEAVY LOADS

By

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and

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THE Konkan cultivator has always to face the strenuous task of carrying from the steep forest hills heavy loads of grass and brushwood for *rabbing* and thatching purposes, and loppings of forest plants for erecting temporary hedges in order to protect his crops. A cheap, yet ingenious device, locally known as *baila* is used by this intelligent cultivator for carrying such loads over long distances from the forest.

Specifications

A *baila* is a carrying pole made of wood. It consists of a cylindrical pole of a light but strong wood 6 ft. long and 2 in. in diameter (Plate 157). Its upper end is smooth and tapering. The lower end is flat or rounded. About three feet from the lower end a vertical rectangular slit 3 in. × 1 in. × 2 in. is cut through the centre of the pole. A horse-shoe shaped stout piece made of a jungle creeper, known as *lokhandi* (*Ventilago madraspatama*), is held in position at right angles to the pole, between two strong wooden pins of the size 1 ft. 6 in. × 1 in. × 1 in. which are inserted into the slit, one above and the other below the arms of the horse-shoe bracket which is 11 in. × 9 in. The bracket passes round the pole, and its arms are secured firmly by the two fitting pins. The bracket ends are tied in the fashion of a bow with a string and a thick coir pad is woven over it. Generally strings prepared from fibre extracted from jungle creepers are used for weaving the pad. Sometimes a bifurcated twig resembling a catapult handle is also used in place of the bracket. The weight of the pole thus prepared varies between four to five pounds, and the cost comes to 10 to 12 annas a piece.

The pole is very useful for carrying down loads from high hills in the forest, and it is specially suited for carrying loads of prickly plant material which cannot be lifted with the hands and carried over the head.

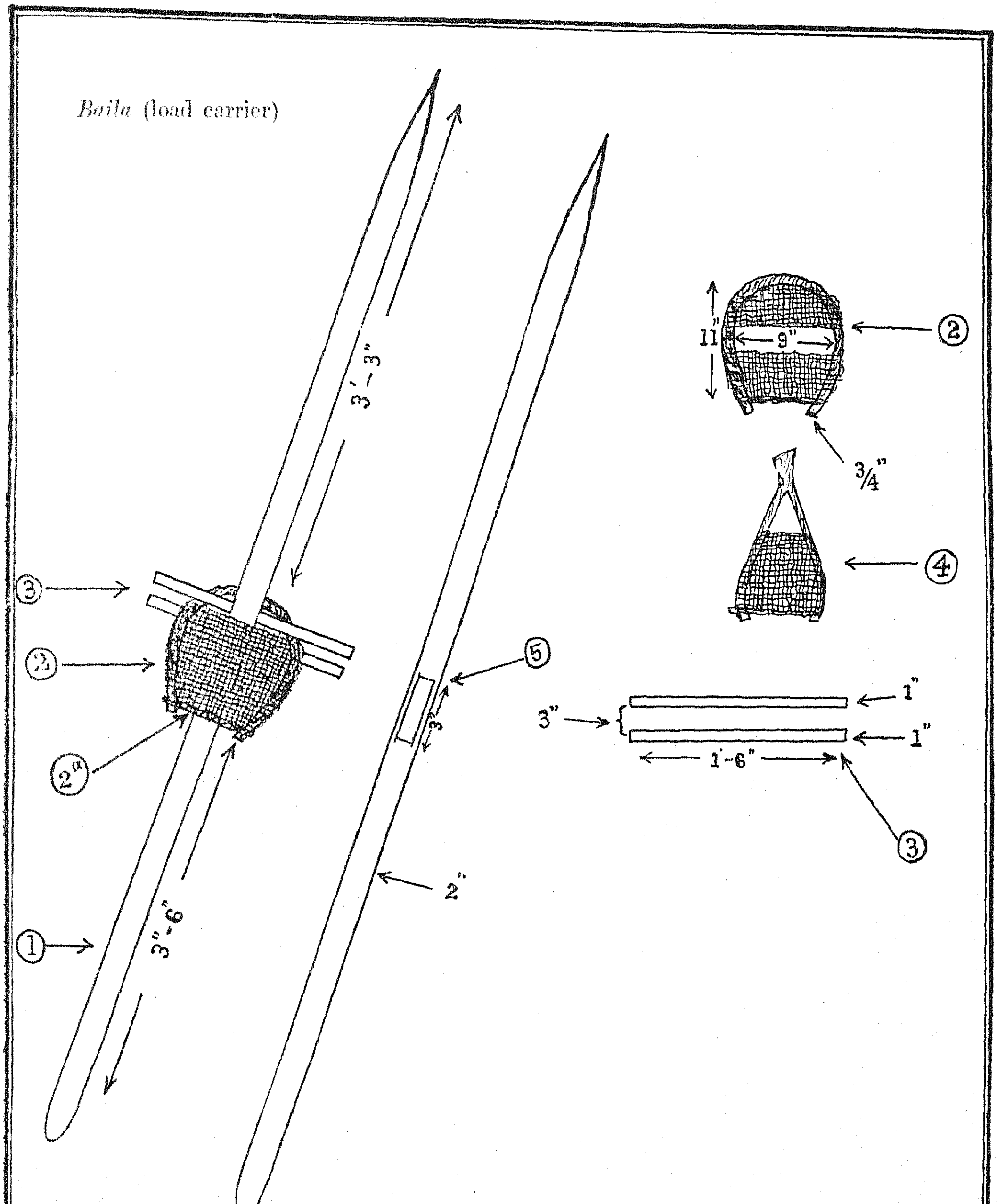
How it is used

The material to be carried is first arranged and tied into a compact bundle. The pole is held at the lower end and its upper pointed end is inserted and passed through the centre of the load. The load is gradually raised above ground, as if by a lever, and the pole is then held in a perpendicular position with its lower end resting on the ground, while the load is propped up by the bracket. The bearer then bends down and supports the load by his head against the coir pad and slowly gets up with the load. He holds the lower end of the pole in one of his hands and balances the load with the other while carrying it (Plate 158, Fig. 1).

Whenever he is in need of rest, he bends down near a tree and places the lower end of the pole on the ground with the load leaning against the trunk of the tree (Plate 158, Fig. 2). After rest he takes up his load unaided and resumes his toilsome journey.

Economical device

The maximum weight lifted unaided and carried on the head supported by a *baila* by a strong *katkari*, is about 120 to 140 lb., while without a *baila* a load of even 100 lb. could not be lifted without some help. With the help of the pole, the bearer can rest whenever he likes and conserve his energy so that he can carry independently a heavier load over a longer distance without tiring himself. The device is very cheap and is made up entirely



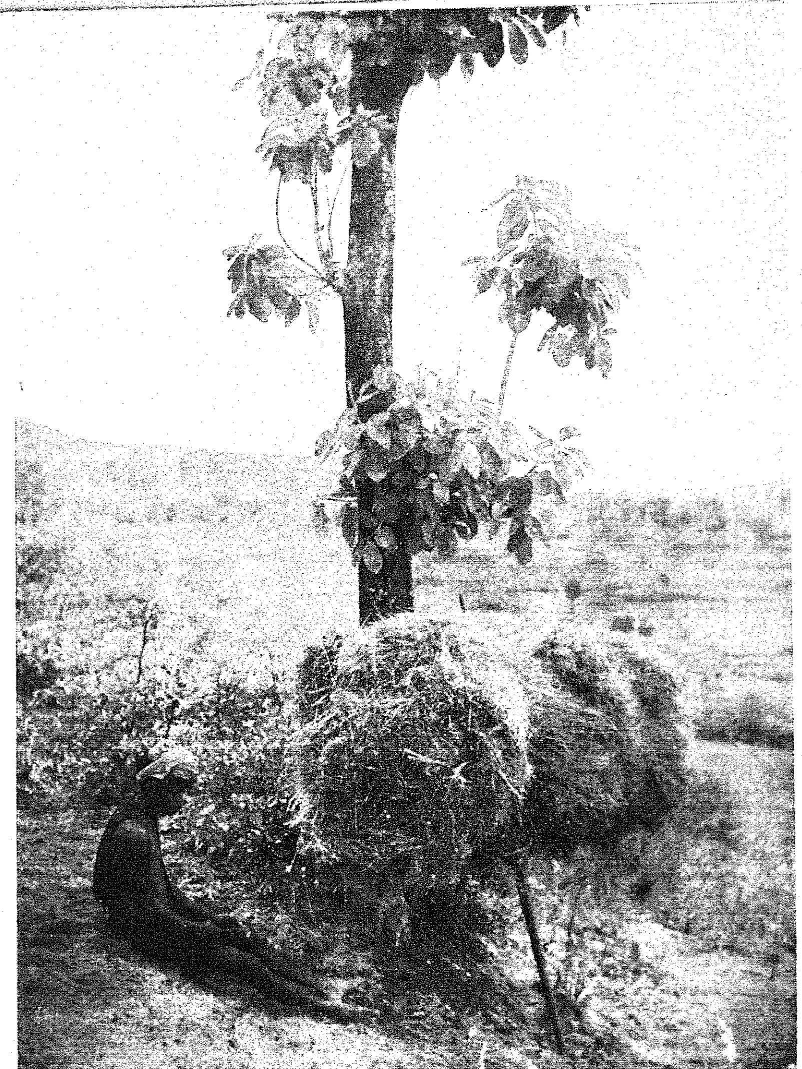
1. Pole, 2. Creeper ring, 2(a) Coir pad, 3. Pins of hard wood,
4. Wooden bracket, 5. Rectangular slit.

V. G. Indulkar

A *baila* and its different parts with measurements

V. G. Indulkar

Fig. 1. A cultivator carrying a load of grass downhill with the help of a *baila*.



V. G. Indulkar

Fig. 2. A cultivator at rest, with his load kept in a characteristic position against a tree on a hill slope.

of material easily available in the forest. It is specially suited for carrying thorny hedge material of *karawand* (*Carissa carandus*), *chilar* (*Cæsalpinia sepiaria*), and *kande-sabar* (*Euphorbia nerifolia*) which are commonly used in the Konkan.

A conical iron shoe, like that of a cross-staff, provided at the lower end of the pole, will enable the bearer to rest the load better in an inclined position against a tree, to avoid the pole from slipping. An iron bracket, instead of the wooden one, will be more durable, but these improvements will involve some more expenditure and might slightly add to the weight of the pole.

Considering the great utility, cheapness and simplicity of mechanism no device will equal the *baila* for the purpose of supporting head loads of brushwood and other plant materials.

WHY CATTLE NEED MINERALS

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WORK was started in 1935 at Coimbatore, under a scheme financed by the Imperial Council of Agricultural Research, to study the requirements of calves and cows for calcium and phosphorus. The experimental animals were fed with rations containing known amounts of the minerals, and the quantities excreted were determined; by subtracting the quantities excreted from the quantities fed the quantities retained in the body of the animals were determined. If more was consumed than excreted, the animals were considered to be getting sufficient for their needs, and if the quantity excreted was more than that consumed, the animals were considered as not getting sufficient for their needs. The requirements for a given mineral was estimated by the quantity required to be consumed to just balance the amount excreted.

Chronic deficiencies

As a result of this work it was found that a heifer calf from the time it was weaned up to the time it grew up and matured, required about 1 oz. of calcium and 1 oz. of phosphorus daily in its diet to supply its requirements for growth and bone building. When the heifer was pregnant and up to the time the calf was born the requirements for the minerals remained of much the same order; with the onset of lactation in the cow it was found that the requirement for phosphorus remained at about 1 oz. but the requirement for calcium depended on the quantity of milk given. A cow giving about 15 to 20 lb. of milk per day required 2 oz. of calcium per day, and proportionately greater quantities for greater quantities of milk yielded. The requirement for calcium was appreciably higher in the cow in milk than when she was pregnant or when she was a young growing animal. The rations fed during the experimental period were liberal ones providing an ample supply of concentrates consisting of cotton seed, groundnut cake, rice bran, *dal* husk, and green *cholam* or maize fodder or guinea grass or green grass; in addition 1 oz. per day of mineral mixture consisting of bonemeal and shell lime were given. This ration was fed on a sliding scale according to the size of the animal. The ration was liberal and provided for sufficiency of all nutrients, i.e. proteins, carbohydrates and fats and mineral matter for calves and heifers, but with the cows in heavy milk it was not found to be possible to supply sufficient calcium for their requirements and the animals were always excreting more calcium than what they got in their food. The quantities of phosphorus were usually sufficient. It is plain that a heavy-yielding cow is chronically in a state of deficiency for calcium, even with a liberal ration *plus* a mineral supplement.

Valuable data at Coimbatore

The experiments at Coimbatore have given data on (i) the requirements of calves, heifers and milking cows which have not been known till now, (ii) have shown that even with a liberal ration as fed on Government farms, unless the ration contains 1 oz. of mineral mixture, it does not supply sufficient mineral matter to meet the needs of calves and heifers, and (iii) that with the cows yielding 15 to 20 lb. of milk per day, the liberal ration fed with the mineral mixture was not able to supply sufficient calcium to supply their requirements.

No experiments were conducted with working bullocks, but the results obtained at Dacca (Bengal) by I. B. Chatterjee have shown that bullocks on a ration of paddy straw and linseed cake required about the same amount of calcium per day, i.e. 1 oz. and about a quarter of that quantity of phosphorus for their daily requirements.

Analysis of pastures

A study was also in progress regarding the mineral content of natural pastures in the province by a pasture survey. Samples of grasses from all parts of the province were

obtained and analysed for their chemical composition with special reference to their mineral value. It was seen that while in the greater part of the province, the grasses had a good content of both calcium and phosphorus, those of the Malabar district were poor in both the minerals, the northern part of Salem district had a low calcium content in its grasses, while in Kurnool and parts of the Anantapur districts the calcium content was good but the phosphorus content was very low. The east coast districts had natural pastures of high nutritive value, and also the Coimbatore district in the south. The area of deficient minerals was therefore the Malabar district, while the North Salem and Kurnool district and parts of Anantapur were areas of imbalance with a good calcium and low phosphorus content.

Deficiency disease

When these results were studied in connection with the condition of the cattle in the areas, it was seen that in the areas of deficiency, i.e. Malabar district, the cattle are generally short in stature and in poor condition, and that good cows when introduced there rapidly deteriorated in yield of milk and in general condition. This could be explained by the poverty of the pastures in both minerals. In the Kurnool district the cattle, though in general satisfactory in condition, suffered in some talukas from a disease known locally as *Vayu-potlu* or *Vayu-noppulu*, diagnosed as rheumatic arthiritis, which results in the animal being crippled by swelling and pain in the limbs, and unable to do any work. This disease affects working bullocks mainly but a few cases occur among cows and fewer among buffaloes. This disease is associated with an imbalance between calcium and phosphorus in the natural pastures of the area; the calcium content is high while the phosphorus content is very low.

Blood studies were conducted at Coimbatore and it was seen that the blood also had an abnormal imbalance of the minerals in it.

The study of the disease was extended to the water supplies of the areas where it occurred in a severe form and results revealed the presence of an element, fluorine, in the well water. Fluorine affects the absorption of phosphorus into the animal body after digestion and its presence probably aggravates the effects of a poor supply of phosphorus in the food of cattle in the affected areas. Further studies are in progress to find methods for the prevention and cure of the disease along the lines of the use of a mineral mixture to supply sufficient phosphorus lacking in the food and to remove the fluorine in the water of wells in the affected villages by a simple method.

Prevention and cure of deficiency

The results of the Coimbatore experiments have shown not only the importance of the problem of mineral matter to cattle, but also a way of overcoming deficiencies in its supply. In all experiments described above a mineral supplement was used to balance the supply of calcium and phosphorus to the animals, so that in addition to the calcium and phosphorus they consumed in the rations, additional quantities of the two minerals could be drawn upon from the mineral supplement fed to the animals. The mineral supplement consisted of equal parts of burnt shell lime and steamed bonemeal ground into a fine powder, mixed in equal proportions. Both shell lime and bonemeal are cheap and easily available in this province. The burning of shell lime and steaming of bonemeal are comparatively simple processes, and as a result the mineral mixture can be had easily and cheaply. Such a mineral mixture is available at about Rs. 6 per cwt. There are many other mineral supplements put up in various forms on the market, but those cannot compete in price with the mineral supplement used at Coimbatore.

By the use of the mineral supplement, animals which are suffering from a gross deficiency of the minerals of any one, or an imbalanced supply of either in relation to the other in their food are enabled to make good the deficiency or imbalance. For cows or calves which are generally under-nourished as regards minerals, or for animals living in a mineral-deficient area, the mineral supplement will make good the deficiencies and prevent the onset of symptoms of disease caused by the deficiency.

The table below gives approximate quantities to be fed to calves, cows, bullocks and

breeding bulls. No information is available for sheep, goats and pigs and hence no recommendations have been made for these animals.

Class of animals	Quantity of mineral mixture per day	Remarks
Calves 0-18 months .	1 oz.	
Heifers 18-24 months .	1 ,,	Also when pregnant
Cows in milk . .	2 ,,	If yielding above 20 lb. per day, an extra $\frac{1}{2}$ oz. per day
Cows dry . . .	2 ,,	
Bullocks working .	1 ,,	To be increased to $1\frac{1}{2}$ oz. in animals above 1,500 lb.
Stud bulls . . .	2 ,,	

The mineral mixture should be fed mixed with the concentrate ration since it often has a smell which some animals do not relish, though they get used to it in course of time; if fed with concentrates the smell is not marked.

In the areas known to be deficient in the minerals, i.e. Malabar, Kurnool, North Salem and probably Tanjore districts, the quantities recommended above may be doubled to meet deficiencies of the minerals in the natural pastures.

The use of the mineral mixture should be constant. It is no use to feed it for a day or two and then to discontinue its use. Mineral mixture is cheap and in the quantities recommended will not cost more than one pie per day per animal.

HIVING *APIS INDICA* COLONIES

By Thakur Jagadish Narayan Singh

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ON a sunny morning or evening, if one goes round some flower trees and plants having a nectar flow, one will find a number of *Apis indica* busy with the flowers. This indicates the presence of ' bees ' in that locality. One should then try to look for nests of white ants which are found in abundance in this part of the country. Only such nests which rise above the ground-level should be taken note of and visited. The entrances to the nests are through holes big and small. Inside the nests there will be found a few roomy compartments which the white ants had made and have now left vacant.

The scout bees locate such nests and lead the queen and the workers to them. This generally happens in the following circumstances:

(1) when the queen and the workers have come out of an old colony during a swarming period,

(2) when an existing colony has been disturbed, and

(3) when the colony dislikes its present nest and desires to change its abode.

When such a white-ant abode which some bees are entering and others leaving has been located, it may generally be taken to contain a colony. But this does not prove to be true in all cases. It may be that the scouts are only searching for a suitable abode: therefore the incoming and outgoing bees should be observed carefully. If none of the bees is found with pollen, they should not be disturbed but watched for some days, till they settle and start working. On the other hand, if some bees are found bringing in pollen on their hind legs, this will confirm that the colony is there and working smoothly.

When colonies are found in walls the same method of observation and confirmation should be applied. Colonies are also found in hollows of trees or at their bases but in either case, due to their being in shade most of the time or always, even a slight disturbance makes them angry. It is difficult and tedious to catch a tree-inhabiting colony, as it requires cutting much wood. This article, therefore, is confined to colonies living underground or in walls.

Advantages of Newton hives

A Newton hive* without the super-chamber is almost as handy as a small cardboard or wooden box generally used for capturing colonies of bees. It can be easily carried in the hand or on a bicycle carrier. Its use for capturing colonies of bees has the following additional advantages:

(i) The located colony's own combs with brood can straightaway be fixed on its frames and the colony gathered in the hive. This procedure facilitates the capture of bees as they have a natural preference for combs and brood and therefore more readily cluster round them than they do in an empty cardboard or wooden box.

(ii) It saves the trouble of transferring the colony from a cardboard or wooden box to another hive on bringing the colony to the apiary.

Catching and hiving the colony

An absolute beginner in beekeeping will find it a little difficult to handle the bees which he has spotted, but a little self-confidence and patience will go a long way in handling them successfully even at the first attempt.

Before starting on the venture, the collector should have the following articles with him:

(1) Artificial Newton's hive without the super-chamber

* A Newton hive consists of a main breeding chamber and a smaller one called a super-chamber which serves as an overflow or auxiliary chamber in which the superfluous honey is collected.

(2) A spade (*phawra* or *kodali*)
(3) A small hoe with only one prong (*khurpi*)
(4) A pair of scissors
(5) A sharp knife
(6) A piece of old dry clean cloth
(7) A dozen pieces of fairly long dried plantain fibres of $\frac{1}{4}$ in. width soaked in water
(8) A match-box
(9) A 20 ft. rope of $\frac{1}{4}$ in. thickness
(10) A coolie or assistant
(11) A bee-veil
(12) A pair of bee-gloves; if leather gloves are not available ordinary cotton gloves will do
(13) A small quantity of liquor ammonia or Kaviraj K. P. Dey's Ascharjya-malam (Howrah)
(14) A pair of fine forceps

The first thing to do now is to clear the place by cutting down all the bushy plants which are usually found around the white-ant nests. Next, observe on which side of the nest the bees are entering. This indicates the position of the colony. Now dig slowly a little above the entrance till the colony is actually seen. As soon as the colony is seen or if accidentally some bees are hurt, stop digging further and move away a little till the bees get cooled down. Now slowly remove with the *khurpi* all the side and top earth so that the colony gets absolutely exposed. At this stage care should be taken that the bees do not enter into any other hole inside the nest. To avoid this, all that is to be done is to close them with lumps of earth. Very slow and careful manipulation is absolutely necessary; otherwise the bees will fly away or attack. When the colony is fully exposed, the combs with bees on them will be seen as in Plate 159 Fig. 2.

Fixing combs to the frames

Insert your naked or gloved hand in the nest and hold the first available comb lightly, taking care that the bees on it do not get crushed. Give the comb a slow and gentle twist, this will make the bees move up the comb and ultimately leave it for other combs or places in the nest. Then remove neatly the complete comb from the nest and blow off the bees that even then remain sitting on it; they will by themselves join the colony again. Repeat the process till all the available combs have been removed from the nest. This will leave the bees without combs in the nest and they will generally cluster together at one place. If the tops of the combs removed are not straight, make them so by trimming the tops a little with the sharp knife, taking care that the combs, especially the young grubs and pupæ are not damaged. Then tie them to the frames of the artificial hive with the moist plantain fibre. Each comb should be tied to the frame in two places as shown in Plate 159 Fig. 3. First turn the frame upside down and ask your companion to hold it. Place the comb inside the frame. Take the plantain fibre from A and tie one side of the comb at the upper end B. Put a knot there and then again tie it up to the other end of the frame at C. Tie the remaining combs to the frames in the same way.

Many experts have recommended 'comb fixers' which are made of metal. But these comb fixers are not suitable when the colony to be hived is far away from the apiary. In carrying the hive to the apiary, it gets jerks and the combs either get damaged by the fixer or they fall. But the plantain fibre holds the combs tightly and does not damage them much. Care should be taken that the width of the fibre should not be less than $\frac{1}{4}$ inch.

When all combs have been tied to the frames, introduce the latter to one side of the hive and put the top on and close it with the hooks.

Bees in the artificial hives

Take up your old piece of cloth, tear a piece of about 2 ft. long and 8 in. broad from it and roll it up into an 8 in. long roll. Light one end of it, and when it has burnt a little, blow off the flame to create smoke. Slowly smoke the bees for a while. This will make them numb.

Now prepare a platform just over the colony in the white-ant nest touching the bees as shown in Plate 159 Fig. 2. Remove the bottom of the artificial Newton's hive and place it over the platform as shown in Plate 159 Fig. 4.

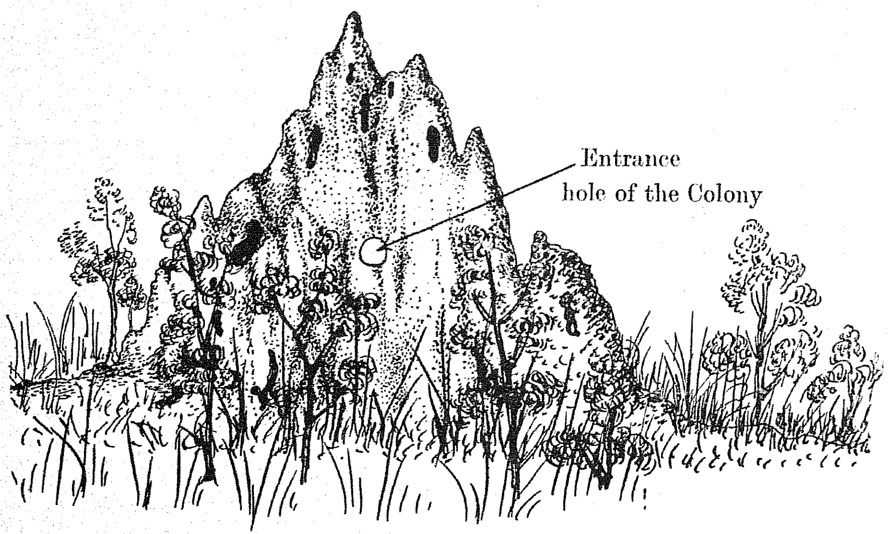


Fig. 1

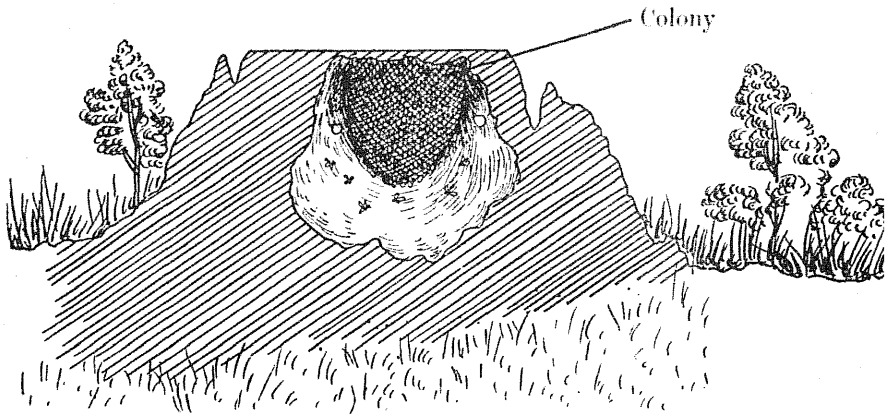


Fig. 2

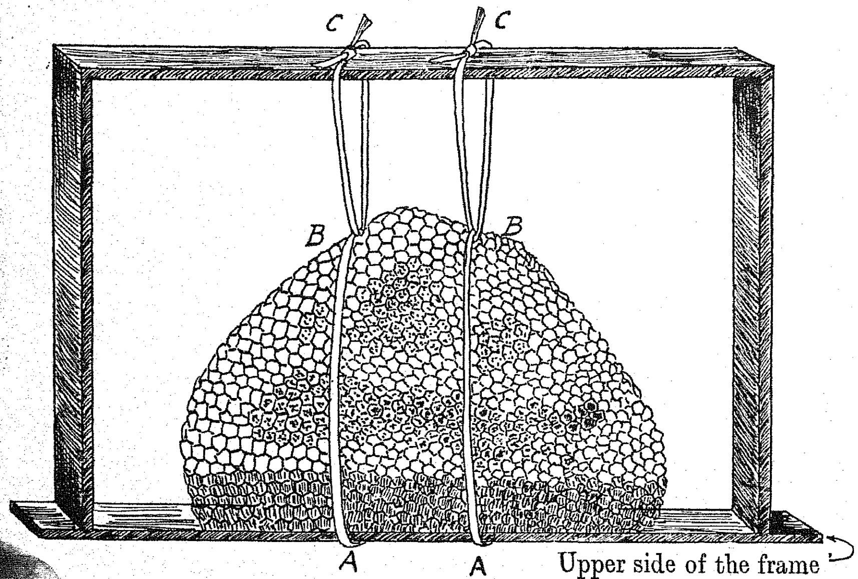


Fig. 3

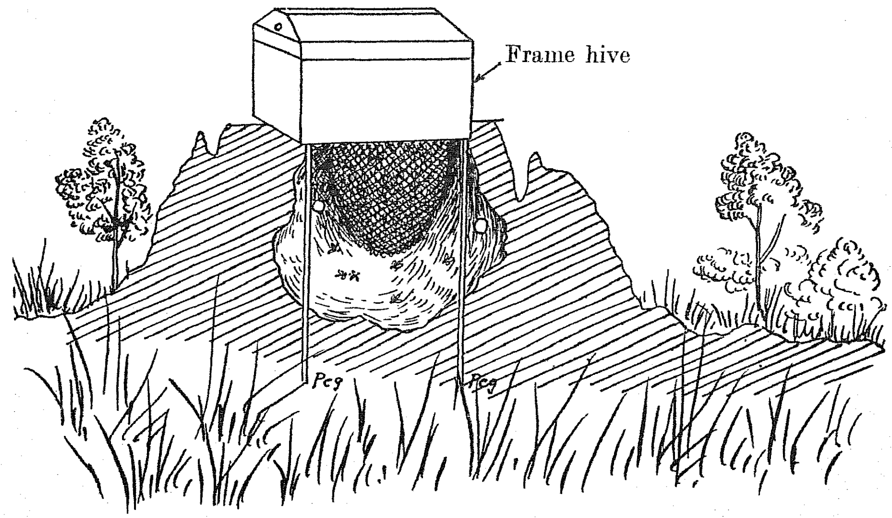


Fig. 4

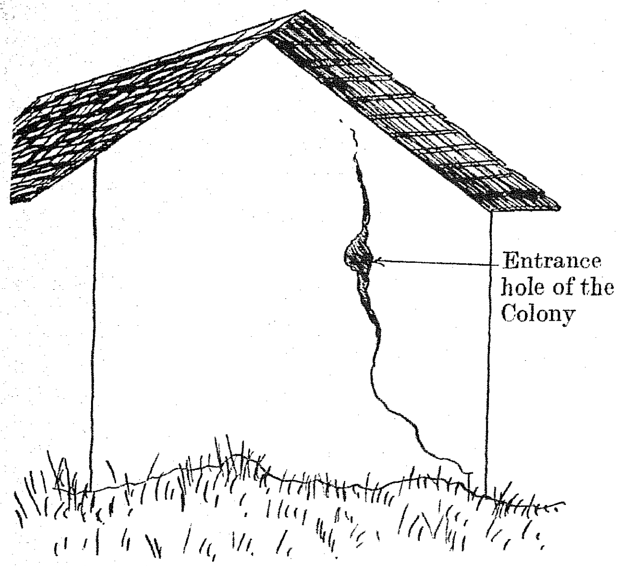


Fig. 5

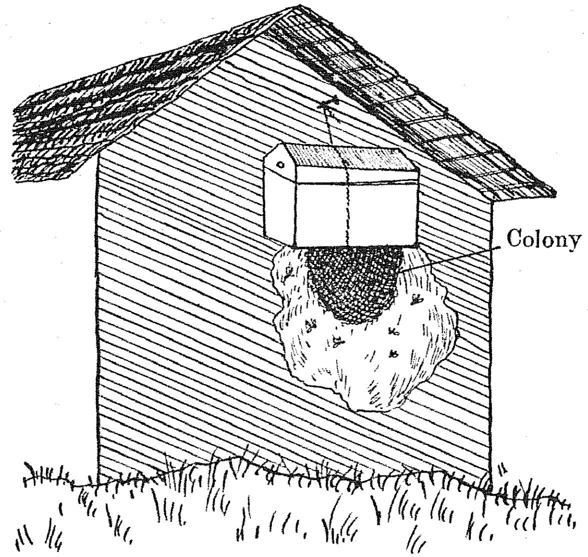


Fig. 6

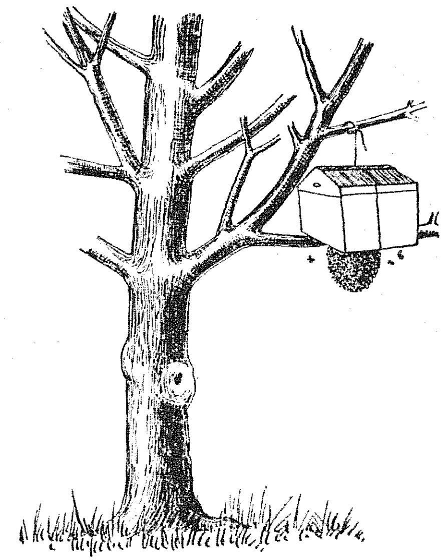


Fig. 7

The side facing the collector should be made to rest on two wooden pegs or mud supports. The bees are now close to the frames fitted with combs taken out from the white-ant nest. Smoke the bees again a little. If the bees have started getting in they should be persuaded further by a gentle push of the hand at the bottom of the bee-cluster. If one is a beginner, gloves may be necessary ; otherwise they can be handled with the naked hand. Putting on the gloves, however, helps to finish the job in a shorter time without fear of being stung. When working without gloves care has to be taken that the manipulation is very slow and the fingers do not move while lifting up the cluster, otherwise there is a possibility of getting stung. If the manipulator does get a sting, he should not remove his hand from the hive with a sudden jerk as this will irritate the bees and make them sting further. Remove the hand slowly and blow off the bees from the hand if there are any. Pull the sting out from the hand with the pair of forceps with a jerk and at once apply the liquor ammonia or Ascharjya-malam at the place from which the sting has been taken out. This will reduce pain and prevent swelling. Stop manipulating for a short time to allow the bees to cool down and also give time to the ammonia to evaporate from the hand. Now repeat the process of pushing up the bees slowly till all the bees get up and distribute themselves on the combs. If there are not enough combs in the hive some of the bees will hang in a cluster on the frames.

In hiving the bees it is important that the queen gets in. Once the queen has entered other bees will follow quickly. If the bees are coming out of the hive, it indicates that the queen has not entered the hive.

When all bees have entered the hive, remove it from the platform and place it on the bottom piece and close the entrance with a piece of cloth.

Hiving in an awkward position

Experience has shown that if the colony is at an unsuitable place where a platform close to the bees cannot be made, the best method is to fix the Newton hive on to a peg or hold it with the hand or a rope, at a distance of four to six inches or more away from the cluster. The bees from the cluster have to be swept into the hive, little by little, by hand. The sweeping hand, with bees on it, should be touching the bottom of the hive and the frames, so that the bees rise up into the hive. This process takes a little longer time in completing the hiving of bees and should be attempted only when the colony is in a cluster and are not spread in the mud hive. See Plate 160 Figs. 5 and 6.

If the bees are spread in the mud hive, they can be gathered in two ways. (1) The bees should be gathered with a gentle sweep of the hand and persuaded to make a cluster. Once they have been induced to make a cluster, they may be hived as described above. (2) The bees should be smoked a little. This will make them get up in the hive. Too much smoking should not be resorted to as it is disliked by bees.

Absconding of the colony

If the queen has been smoked too much, she tries to fly away and the other bees immediately follow her. When this happens they should be followed. Generally they sit on a tree near by, but sometimes they fly far away or sit too high on the top of a tree. In either of the latter two cases it is almost impossible to catch them again.

As soon as the queen sits on the branch of a tree, the following workers sit in a cluster round her. If they are within reach, place the Newton's hive over the branch and tie it up with the rope, and push up the cluster with the hand from below as shown in Plate 160 Fig. 7. They rise up quickly. This can be accomplished in less than five minutes. When all the bees have entered, take the hive off the branch, fix the bottom on it and close the entrance with a piece of cloth and tie the bottom to the hive with a rope.

I am against introducing the cluster into the hive by tapping as they do not get into the hive as happily as they do according to the method explained above.

Carriage to the apiary and first care

The colony is now captured and the hive is ready to be taken to the apiary. In

[PLATE 161

transit, shaking the hive should be avoided as it causes suffocation, damage to combs and death by crushing of many of those bees which happen to come in between the frames.

After the bees have been brought to the apiary the hive should be placed in a suitable place facing east. The super-compartment should be added only after the bees have cooled down. Later they should be given a syrup made of one part sugar to two parts of water. The syrup may be poured into an empty cigarette tin and covered with a fourfold muslin cloth tied on it tightly. The tin of syrup should be inverted and rested on the frames on two small sticks so that the bees may suck the syrup from below easily. Feeding should be continued till it is felt to be unnecessary, i.e. till the bees begin to collect their own food.

The hive should be examined after three days. By that time the bees will have joined all combs to the frames, cut down all plantain fibres and removed them. Frames should be lifted carefully, taking particular care that the newly joined combs do not get disjoined and the combs with bees on them fall. If this happens the combs will get damaged, and the hurt and irritated bees will sting the beekeeper and others who happen to be near.

If the queen is seen, her wings should be clipped with a fine pair of scissors. This will prevent the colony from absconding. After this the general apiary technique should be followed.

THE MONSOON OF 1941

By C. Ramaswamy, M.A.
Assistant Meteorologist, Poona

THE monsoon burst on the Malabar coast on the 22nd May. In association with this outburst, a cyclone formed in the south-east Arabian Sea near the Laccadives and struck the Malabar coast between Calicut and Cochin on the 26th. It caused severe floods and considerable loss in coconut plantations and paddy seedlings in Malabar in the last week of the month. About the same time a severe cyclone from the Bay of Bengal swept over south-east Bengal and prepared the way for the advance of the monsoon in north-east India.

The monsoon strengthened again in Malabar on the 1st June and rapidly advanced into the interior of the country. By the end of the first week it had extended its sway over most of the country outside north-west India, and before the 11th, had invaded practically the whole of north-west India outside Sind. The north Madras coast had very heavy downpours at the beginning of the month. But this exceptional activity of the monsoon lasted only for a short period; both branches of the current became generally feeble after the 12th and remained so till the 25th. On account of this, many regions which received abundant rainfall in the first twelve days of June had actually a deficit at the end of the month. The dry spell was fortunately broken towards the close of the month by a depression from the Bay of Bengal which carried rain into the region extending from Bengal to east Gujarat and the Konkan.

Floods and drought

At the beginning of July, the last depression of June was still vigorous and caused concentrated and phenomenally heavy rain in the coastal districts north of Bombay and in Gujarat. It also extended the monsoon into Sind and gave copious rainfall in the Konkan, the Bombay Deccan, and from the east Central Provinces to south Rajputana. The prodigal outburst in Gujarat was attended with severe floods and loss of livestock and property, particularly in the Broach and Surat districts. A number of bridges collapsed and railway traffic was seriously disorganized by the floods. During the second week, another depression from the Bay of Bengal again caused some very heavy falls and more floods in east Gujarat. After this depression became unimportant, the monsoon became feeble and continued so till the end of the month. There were, however, plentiful thundershowers in and around the south-west Punjab and along the western Himalayas in the third week. According to press reports, the weakening of the monsoon in the latter half of July caused agricultural operations to be held up in the Konkan, the United Provinces and the east Central Provinces.

The total rainfall during July was more than twice the normal in Gujarat, but was 50 per cent or more in defect in east Rajputana, the United Provinces, the Konkan, the south Deccan and south-east Madras.

Agriculture suspended

During August the Bay of Bengal monsoon gave satisfactory rainfall in north-east India and the United Provinces. It is reported that this rainfall greatly benefited the standing crops in the United Provinces and Bihar. The Arabian Sea current was fairly active on the west coast of the Peninsula and in the Deccan and Mysore during the first week and in Malabar and the north Deccan during the second. In the second and third weeks, two depressions from the Bay of Bengal activated the monsoon in the west Central Provinces, Berar, west Central India and Rajputana and partially made up the deficiency in rainfall in these regions. During the last week, the activity of the monsoon was mainly confined to north-east India and the east United Provinces. According to press reports, the

shortage of rainfall aggravated the agricultural situation in the Konkan and caused anxiety in the Deccan. It is also reported that the continued deficiency of rain in the east Central Provinces led to withering of standing crops and suspension of agricultural operations. The month's rainfall was about 85 per cent in excess in west Central India and 50 per cent or more in defect in the Konkan, Gujarat, Sind, Baluchistan, the south-west Punjab, Kashmir, south-east Madras and the north Madras coast.

September was a month of good rainfall in north-east India, the Madras Presidency, Mysore, south Hyderabad and the Bombay Deccan. The first eleven days of the month were marked by the movement of two depressions which gave abundant rains in north-east India, the east United Provinces, Central India, the Punjab and Kashmir. During the third week and the beginning of the fourth, another depression moved from the Bay of Bengal across the Deccan into north Bihar. It caused good rainfall in most parts of the Peninsula, in the west Central Provinces and from west Central India to Assam. The rains in the Deccan were particularly welcome as they helped to relieve the drought conditions prevailing there.

The monsoon withdrew from north-west India, the United Provinces and the central parts of the country by the end of the third week of September. During the rest of the month, its activity was mainly confined to Bengal and Chota Nagpur. South-east Madras had, however, copious thundershowers during the last week. The monsoon withdrew from the country finally by the 2nd October.

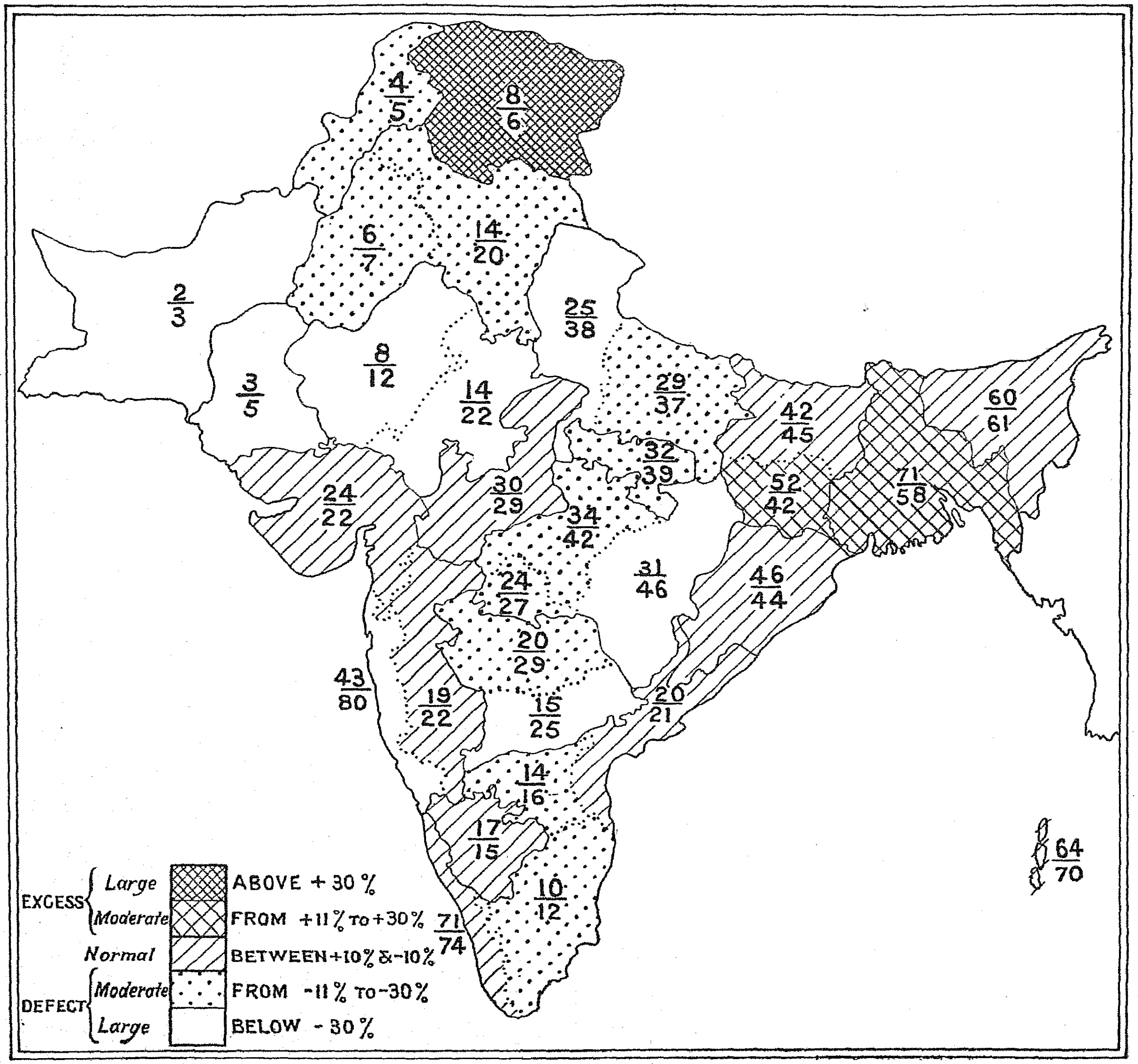
Early but erratic

Considering the season as a whole, the monsoon burst over the country earlier than usual but, except in north-east India and Malabar, it displayed its activity in spells of heavy rain with rather long breaks in between. The Arabian Sea monsoon was generally weak, being conspicuously so in the second fortnight of June and July and the last third of August. The regions which suffered most from an erratic or feeble monsoon were Gujarat and the Konkan. Although the rainfall for the season in Gujarat was nearly normal, most of it fell in two spells totalling about 12 days. The Konkan had abnormally deficient rainfall during most of the season. Sind was practically rainless except in the first half of July.

The total rainfall during the season was more than 40 per cent in defect in the Konkan and Sind. It was 30 to 40 per cent in defect in Baluchistan, Rajputana, the west United Provinces, the east Central Provinces and south Hyderabad. The only sub-divisions which had an appreciable excess of rainfall were Kashmir, Bengal, and Chota Nagpur. Averaged over the plains of India, the total rainfall was 11 per cent in defect.

Plate 161 shows the actual and the normal rainfall for the period June to September 1941 in the different sub-divisions of India. The table on the page 643 sets out the progress of the monsoon week by week in the various sub-divisions. The graphs on Plate 162 show the daily march of the monsoon in the four major divisions of the country and in the Konkan and Gujarat.

Differences of actual from normal rainfall
June to September 1941

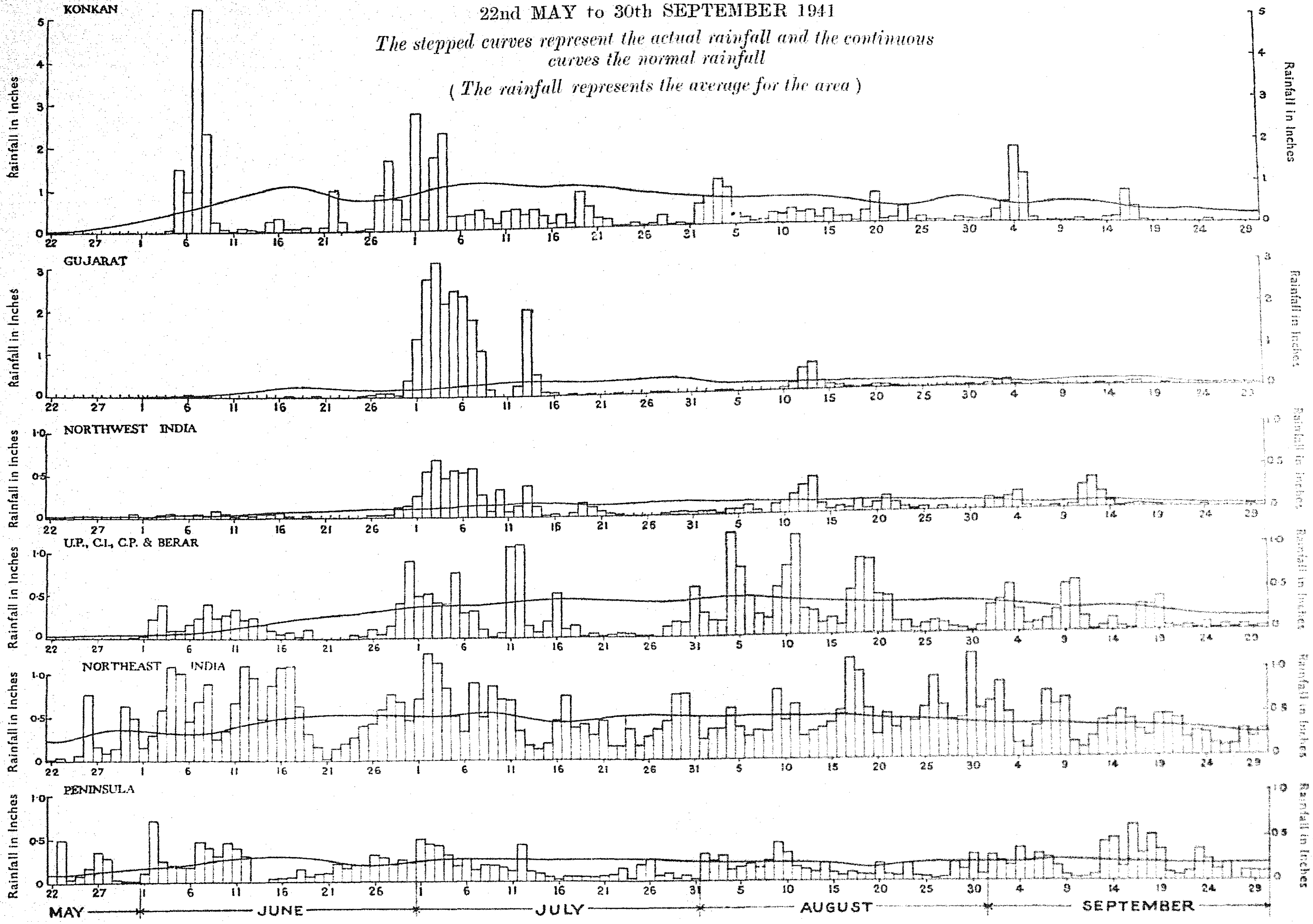


[PLATE 16]

22nd MAY to 30th SEPTEMBER 1941

The stepped curves represent the actual rainfall and the continuous curves the normal rainfall

(The rainfall represents the average for the area)



Progress of the monsoon week by week, 1941

Division	Week ending																		
	28-5-41	4-6-41	11-6-41	18-6-41	25-6-41	2-7-41	9-7-41	16-7-41	23-7-41	30-7-41	6-8-41	13-8-41	20-8-41	27-8-41	3-9-41	10-9-41	17-9-41	24-9-41	1-10-41
1. Bay Islands	1·4	0·6	0·4	0·3	2·3	0·9	1·9	0·1	0·3	0·4	1·0	0·7	0·3	1·0	1·1	3·1	0·8	0·2	0·9
2. Assam	0·5	1·7	1·4	1·1	0·8	0·5	0·4	0·6	1·1	1·1	0·9	0·6	0·4	1·5	1·8	1·0	1·6	2·2	1·0
3. Bengal	0·6	1·4	1·8	2·8	0·3	1·1	1·3	0·7	1·1	0·9	0·7	0·8	1·5	1·2	1·9	0·7	1·0	0·8	1·0
4. Orissa	0	1·0	2·2	0·7	0·6	1·4	2·2	1·9	0·1	0·5	0·4	1·5	1·5	0·3	0·8	2·1	0·6	0·6	0·8
5. Chota Nagpur	0·2	1·3	2·4	0·8	0·1	2·7	2·8	1·1	0·2	0·8	1·0	0·9	2·5	1·0	0·9	1·7	0·7	0·2	1·1
6. Bihar	0·1	1·5	2·0	1·2	0·1	0·6	1·0	0·7	0·3	0·8	1·4	0·6	0·6	2·0	1·7	1·0	0·1	1·0	0·7
7. U. P., East	0·1	6·9	2·4	1·5	0	0·2	0·3	1·4	0·2	0·2	1·9	0·7	0·5	0·9	1·9	0·8	0·1	0·6	0·3
8. U. P., West	0	6·8	5·0	1·2	0	0·1	0·3	0·5	0·3	0·4	1·5	0·5	1·5	0·3	0·6	0·8	0·1	0·4	0
9. Punjab, E. and N.	0·4	5·7	6·4	1·5	0·1	0·4	1·0	0·6	0·5	0·1	0·6	1·4	0·9	0·3	0·3	0·1	1·4	0·1	0
10. Punjab, South-west	0·6	0·6	3·7	2·7	0	1·2	0·4	1·9	1·9	0	0·1	0·4	0·5	0·8	1·8	1·6	1·7	0	0
11. Kashmir	0·8	0	0·2	1·1	0·1	0·4	3·6	0·9	1·6	0·4	1·0	0·2	0·3	0·4	2·1	1·7	5·4	0·1	0
12. N.-W. F. P.	3·3	0	0	0·7	0	0	0·3	2·3	0·6	0·2	0·1	1·3	0	3·3	2·3	1·0	0·4	0	0
13. Baluchistan	6·4	0	7·0	0	0	0·6	3·1	1·0	2·8	0	0·3	0	0	0·3	0·4	1·7	0	0	0
14. Sind	0	0	0	0	0	0	6·7	0·9	0·1	0	0	0	0	0	0	0	0·3	0	0
15. Rajputana, West	0	0	0	0	0	0·4	2·6	0·2	0	0	0	0·4	3·9	0·8	2·2	0	0·1	0·2	0
16. Rajputana, East	0	0·8	2·8	0·4	0	0·4	0·9	0·3	0	0	0·5	3·0	0·7	1·1	0	0·3	0·6	0·6	0
17. Gujarat	0	0·2	0·2	0	0	1·9	7·6	1·2	0	0	0	0·9	0·4	0	0·3	0	0·2	0·1	0·2
18. C. I., West	0	0·1	0·3	0	0	1·3	3·1	0·8	0	0	0·1	4·4	2·4	1·7	0	0·1	1·0	1·5	1·1
19. C. I., East	0	0·2	21·1	0·2	0	0·2	1·9	0·8	0·1	0·1	1·3	0·7	0·9	0·2	0·1	3·4	0·1	2·9	0
20. Berar	0	0	0·2	0	0·1	2·7	1·8	1·9	0	0	0·1	2·6	0·4	0·1	0	0·7	1·3	0	0·3
21. C. P., West	0	0·5	2·2	0·2	0·1	1·7	1·4	1·3	0	0·1	0·9	2·1	1·9	0·1	0	0·7	0·5	0·6	0·2
22. C. P., East	0·3	1·2	3·1	0·5	0·3	2·1	0·5	1·0	0·1	0·1	0·8	0·9	0·7	0·1	0·3	1·5	0·3	0·3	0
23. Konkan	0	0	3·1	0·1	0·2	1·2	0·7	0·3	0·3	0·1	0·8	0·3	0·5	0·2	0·3	0·9	0·5	0	0
24. Bombay Deccan	0	0·1	1·3	0·1	0·5	3·4	2·8	0·9	0·3	0·1	0·5	0·9	0·3	0·2	0·7	0·7	2·5	0·6	0·2
25. Hyderabad, North	0	0	0·5	0	0·3	2·4	0·4	0·8	0·1	0·1	1·5	2·8	0·3	0·1	0·2	0·7	1·5	0·3	0·5
26. Hyderabad, South	0·6	0·7	0·7	0·2	0·3	1·3	0·3	0·3	0·2	0·1	1·1	1·0	0·3	0·1	0·5	1·3	1·7	0·5	0·1
27. Mysore	0·2	0·1	5·1	0·1	2·5	0·8	0·6	0·5	1·3	0·8	1·2	0·9	0·4	0·7	3·0	1·2	0·4	1·7	0·7
28. Malabar	4·2	1·1	2·3	0·4	1·0	0·9	0·9	0·6	0·2	0·7	1·0	1·5	1·5	0·9	0·3	1·1	1·2	3·3	1·2
29. Madras, South-east	1·6	0·2	5·1	0·2	0·9	0·5	0·5	0·5	0·4	0·6	0·6	0·5	0·3	0·3	2·0	0·6	0·9	5·3	1·4
30. Madras Deccan	0	0·3	4·0	0·1	0·5	0·2	0·3	0·2	0·6	0·4	1·9	0·4	0	0	1·7	0·9	1·7	2·1	0·4
31. Madras Coast, N.	1·7	11·7	1·0	0·2	0·7	2·5	0·5	0·4	0·2	0·8	0·4	0·5	0·5	0·2	0·9	0·5	1·5	1·2	0·1

The figures in the Table represent the ratios of the actual rainfall to the normal rainfall. For example, in the week ending 3-9-41, the figure 1·9 printed against U. P., East, means that in that division, the actual rainfall during that week was 1·9 times the normal.

F

What the Scientists are doing

COLD STORAGE OF PEARS

THE possibilities of the cold storage of Bartlett pears in the Punjab are discussed by Lal Singh and Abdul Hamid, Fruit Specialist and Research Assistant respectively in the Punjab, in an article in the October issue of *The Indian Journal of Agricultural Science* (Vol. XI, Part V). Bartlett pears are very popular with growers in the Kulu valley, but the local demand is slight, and as the fruit deteriorates within a few hours when fully ripe and transportation charges are high, the growers are seriously handicapped in their efforts to find a market for it outside. It is no solution of their difficulty to send the fruit in unripe condition to the hot plains of the Punjab, as it does not ripen at all there but merely shrivels up. Sometimes it does not even pay to pick the fruit, and a good deal goes to the manure pit. This is unfortunate in view of the fact that the fruit is of excellent quality, is greatly liked by people in the plains, and can fetch a good price there if made available.

Experiments conducted at Lyallpur show that pears picked at the right stage of maturity (i.e. when the fruit is hard, green and mature and the pressure tests show resistance of about 16 to 18 lb.) can be transported over long distances and ripen properly at the destination at 60 to 70°F.

The best cold storage temperature has been found to be 32°F at which fruit of the right stage of maturity can be stored for 4½ to 5 months. Bad handling of fruit or inferior quality affects storage life adversely.

After removal from cold storage, the fruit ripens at 60 to 70°F within four to seven days. Fruit should not be allowed to ripen fully in cold storage or in the ripening chamber for sale in the market but should be taken out earlier so that it reaches the consumer when it is just ripe.

In other countries, the cost of storage varies from three to eight annas per maund per month. Even if the cost of storage in India comes to Re. 1 per maund per month, it is maintained that there is a good margin of profit after deducting transport and other charges. This is because pears of even ordinary quality fetch eight annas or more per seer in the market during December-January and still more during February-March. Pears picked and stored in the manner recommended can also be used for canning, and the canning period is thus prolonged by cold storage.

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LINSEED RESEARCH

IT is wellknown that the linseed plant (*Linum usitatissimum* L.) contains fibre in its straw and the available records go to show that the cultivators occasionally use the fibre for making ropes, for weaving their *charpais* or for other domestic use. The bulk of the straw, however, is not profitably utilized. It is either burned or put in the manure pit.

The fibre in the linseed straw is coarse and the plant, as grown in India, being dwarf and bushy, is not suitable for fibre extraction.

The Imperial Agricultural Research Institute, New Delhi, has been engaged for the last six or seven years in breeding linseed strains suitable both for fibre and seed. Crosses between linseed and flax have been successfully effected and several promising strains evolved. Many of these combine the tall habit of flax and the bold-seededness and other economically important characters, such as good tillering, of linseed. The fibre also appears to be superior to that of linseed. Samples of the fibre are being submitted to experts for their opinion. The seeds of a few outstanding strains are also available for trial in small quantities.

Breeding for disease-resistance has also been in progress with encouraging results. We have in the linseed rust (*Melampora lini*) a very serious disease of linseed, both the outturn and the quality of seed being greatly affected by it. The attack is sometimes so

serious that the income does not even cover the cost of harvesting and threshing. There are several physiological races of the linseed rust fungus. All the indigenous Indian linseed varieties are susceptible to varying extent to the form or forms occurring in India.

Some foreign linseed varieties received a few years back proved to be immune to rust. However, they were not suitable for cultivation in India, being very late in maturity. Crosses were made between purified exotic varieties, and some of the outstanding I. P. linseed types. The hybrid progenies are being grown and studied and selections made in places such as Karnal and Pusa, where the incidence of rust is common and usually heavy. Selection for rust resistance is thus being made under conditions of natural infection.

As a result of this investigation several promising strains, combining rust-resistance (immunity) with other economically important characters, such as yield, seed size, seed colour, etc., have been evolved. Some of the more promising ones will be tried in the next cold weather in the important linseed-growing tracts of India. Small quantities of seeds of these strains are available for distribution for trial.

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I A R I RESULTS

THE following students of the Imperial Agricultural Research Institute, New Delhi, have been awarded the Diploma of the Institute (Assoc. I. A. R. I.) after the completion in September 1941 of their two-year postgraduate courses and the acceptance by the Institute Council of theses submitted by them as mentioned against each :

BOTANY

D. Srinivasachar—Studies in the classification of *Oleiferous Brassicae* in India

A. R. Braganza—Seed and embryo weight in its relationship to Heterosis

K. D. Sharma—Morphology and classification of the varieties of *Solanum Andigenum* Juz. et Buk. and their breeding value

AGRICULTURAL CHEMISTRY

D. K. Patel—Studies on phosphate-fixation in Indian cultivated soils

M. K. Reddy—The study of the plate and the direct methods for the estimation of total bacterial numbers in the soil with special reference to the variation of sampling errors with grain size

ENTOMOLOGY

Shumsher Singh—A contribution to the study of Indian *Terebrantia*—classification of Terebrantia with a systematic account of the North Indian genera and species, their distribution and food plants

Chandra Narain Modawal—
- Part I—Studies on the life-history and bionomics of *Chilomenes sexmaculata* Fabr. and its predatory efficiency in the biological control of aphids
- Part II—Review of previous work on the more important pests of cotton in India

MYCOLOGY

Syamaprasad Ray Chaudhuri—
- (1) Studies on the canker disease of pigeon-pea [*Cajanus Cajan* (L.) Millsp.] caused by *Diplodia cajani* Nov. spec.
- (2) Studies on *Erysiphe cichoracearum* Dc and *Erysiphe polygoni* Dc.

SUGARCANE BREEDING

Gur Prasad Seth—
- Part I—Sugarcane breeding as adopted at Coimbatore
- Part II—Different factors in sugarcane germination with special reference to nature of soil, its moisture content and variety
- Part III—A possible method for selecting high-yielding sugarcanes

Jagdish Narain Sharma—
- Part I—Sugarcane breeding at Coimbatore
- Part II—Age determination of a sugarcane culm
- Part III—On the formulae of branching system of some of the sugarcane varieties in relation to poor harvest in some of them
- Part IV—A preliminary study of root primordia in certain sugarcane seedlings and their parents.

The following students have successfully completed the one-year postgraduate course in Agriculture :

Kanshi Ram Chowdhry
K. L. Gurnani

What would you like to know?

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section will be reserved for replies to selected letters in cases where it seems that the information might be of general interest.

Q: I am interested in the manufacture of cheese in order to compete with Dutch cheese and would be glad to receive a tried and successful formula and a bibliography on the subject.

A: There are several varieties of indigenous and foreign cheeses. Some are hard and others soft. The former last longer and the latter are only for immediate consumption. The cheeses which are being imported into this country fall under the former category. The most commonly imported variety of cheese is Cheddar and this is also made at the Imperial Dairy Institute, Bangalore, for experimental and educational purposes. The Director of Dairy Research, Bangalore, will be able to supply you with a note on the process of manufacture of the particular kind of cheese in which you are interested. Before you decide upon this, it would be advisable to gain practical experience in the manufacture of some varieties. The best way would be to take a short-period course, say for three months, at the Imperial Dairy Institute, Bangalore. The following books are recommended:

Cheese-making by Walker-Tisdale
Cheese by Van Slyke
Faults in Cheese by R. N. Leitsch

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Q: We are opening a big Dairy Farm and propose to prepare butter, ghee and condensed milk on a large scale.

Please let us know the latest methods for the regular measurement of milk, converting milk into curd, skimming (scanning) the milk to take out ghee and butter and also how to prepare condensed milk from the scanned milk.

A: It is difficult to describe the methods of manufacture by correspondence. Practical experience is invaluable and a representative of your farm may be deputed for a six months' training course at the Imperial Dairy Institute, Bangalore. The following literature is recommended—

Condensed Milk and Milk Powder by O. F. Hunziker (Rs. 30)
Butter Industry by O. F. Hunziker (Rs. 30) (obtainable from the author, La Grange, Ill., U. S.)
Indian Indigenous Milk Products by Dr W. L. Davies (Re. 1-8. Thacker, Spink & Co., Calcutta)
Report on the Development of Cattle and Dairy Industries of India, by N. C. Wright (Re. 1-8. Manager of Publications, Civil Lines, Delhi)
Studies in making Ghee by desi *and Separator Methods* by Zal R. Kothavalla (*Journal of Central Bureau of Animal Husbandry*—Manager of Publications, Civil Lines, Delhi)
Laboratory Manual of Milk Inspection by A. C. Aggarwal (Gulabchand & Son, Anarkali, Lahore)

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Q: Would you please let me know where I can get bulbils or suckers of authentic sisal hemp?

A: These can be obtained from the Manager, Nildongri Sisal Estate, Sambalpore P. O., Orissa, who will supply quotations.

INFORMATION PLEASE!

Can any reader tell us where Lespedeza seed can be obtained in India?

What's doing in All-India

MADRAS

By T. Vinayaka Mudaliar, G.M.V.C.
Superintendent, Livestock Research Station, Hosur

HOSUR is the hub of livestock activities in Madras. Situated at an altitude of nearly 3,000 ft. and about 29 miles from Bangalore, Hosur enjoys a salubrious climate and an average rainfall of 29 in., fairly well distributed throughout the year. Seventeen years have passed since this station was converted into a cattle-breeding farm. Prior to that, it was a Remount Depot for 96 years, supplying horses to the army. It was given up by them as a measure of retrenchment. Much care and thought had been bestowed by the military authorities on the layout of the farm. It has been described as an 'English park'. It is 1,635 acres in extent. Its green pasture, its roads and its beautiful avenue of trees never fail to arrest the attention of visitors and evoke their admiration. On this 'green velvet of nature' today graze fine specimens of cattle.

Heterogenous group

On 1 September 1924, Mr R. W. Littlewood, the present Livestock Development Officer, took charge of this farm from the military authorities. The first group of animals to arrive was a heterogenous one consisting of crossbreds (Ayrshire-Sindhis), Ongoles, Kangayams and Montgomerys. They were from the Agricultural College, Coimbatore, the Imperial Dairy Institute, Bangalore, and the Chintaladevi Cattle Farm. Though cross-breeding experiments held the stage, it is evident that the importance of building up a Kangayam herd on this farm was fully realized even in those days. As many as 30 Kangayam heifers were purchased from the Pattagar of Palayakottai early in January 1925. On 1 April 1925 there were 54 animals of this breed and they constituted the foundation stock of the beautiful herd of Kangayams we now have on the farm. New blood was no doubt introduced from time to time, and it is from this herd that the supply of stud bulls for most of the districts in this province is made. The breed is popular for its draught qualities. It is something to be proud of that as many as 280 Kangayam stud bulls have been issued from this station up to the end of March 1941. The price of a bull varies from Rs. 150 to Rs. 175. The present stock of this herd is 370.

Success in the Sindhis

Similarly, on 1 April 1925, there were only 10 Sindhi animals. From such small beginnings, it is gratifying to record that this station has been able to supply as many as 178 stud bulls till the end of March 1941. The bulls of this breed are issued to urban areas, to dairy farms and in fact to all centres where milk is the main consideration. The average price of each bull varies from Rs. 150 to Rs. 200. The present stock of this herd is 222.

The cross-breeding experiments were given up in 1932-33. The Ongoles did not thrive well on this farm and their breeding also was stopped in the same year. Work was concentrated on Kangayams and Sindhis until 1935-36, when a small herd of 30 Hallikars was purchased to meet the demand of the central districts, viz. North Salem, North Arcot, Chittoor and Anantapur. This, again, is purely a draught animal and is very fast on road work. Young bulls of one or two years of age have been selling at Rs. 80 to Rs. 100 each. Up to 31 March 1941, 22 young bull

calves were sold. The present stock of this herd is 118.

Pioneers' foresight

The foresight of the pioneers on whom fell the task of organizing livestock work in this province is well reflected in the fact that they did not neglect to take up sheep and poultry breeding. The Bellary sheep—a dual-purpose breed—has been maintained on this farm from the very beginning. There were 170 sheep to start with. Some progress in the way of better yield of wool and carcase has been achieved. Recently, the Imperial Council of Agricultural Research has stepped in and a scheme for grading up these sheep with Bikaner rams is in progress. The present stock of this flock is 351.

As regards poultry, the farm today maintains White Leghorns, Rhode Island Reds, Black Minorcas, Light Sussex and Chittagongs. At the beginning there were only 54 birds, both adults and chickens together. As many as 5,083 birds and 33,332 eggs for hatching have been issued up to the end of March 1941. The present stock is 406 birds.

Berkshire and Yorkshire pigs were also bred and sold. But as the demand was not great, this section was closed down in 1940-41.

Young Murrah buffalo bull calves are bought and reared on this farm and sold to districts where there is a demand for them.

On the agricultural side, the farm lends itself to the study of several fodder crops. Napier grass, guinea grass, teosinte, maize, *jowar*, lucerne, berseem, cow-pea, etc. are grown. Hay and silage-making are a study by themselves. The maintenance of nearly 1,600 acres in perfect condition presents several interesting problems. A small dairy is also attached. The station is now imparting practical training to B.V.Sc. students in dairying, animal husbandry and allied subjects. The best time to visit the farm is from October to December.

Mahanadi cattle show

There is hardly a festival conducted in this part of the country which is not accompanied by a fair.

From time immemorial, such a festival and fair has been held at Mahanandi in Kurnool district. It is a beautiful spot situated on the outskirts of the Nallamalai hills. The temple here is dedicated to the Lord Siva and his sacred bull. There is a cattle show held annually in connection with the festival—Maha-Sivaratri—and the unique feature of this show is the stone-dragging competition by bullocks. This year the show was held on the 24th and 25th February. A granite stone measuring 11 ft. × 2 ft. 3 in. × 2 ft. 3 in., and weighing about 3½ tons is drawn by a pair of bullocks for half an hour. The pair that drags it the longest distance within the allotted time is declared the winner. This year, a new record was created in this competition. The distance dragged was 239 ft. 8 in., beating the previous record of 211 ft. 5 in. in 1938-39. The prize is a gold medal valued at Rs. 30 which is much coveted by the ryots in Kurnool district. This has led to minor stone-dragging competitions at many fairs and festivals elsewhere.

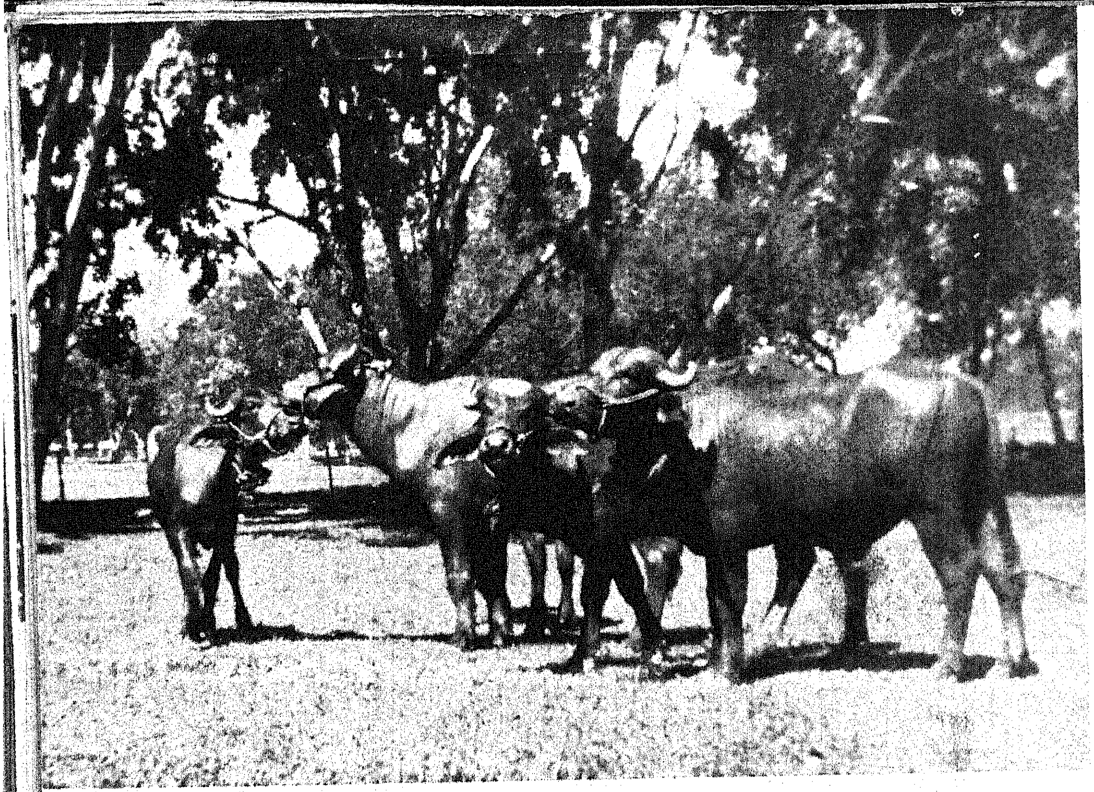
Shiyali S. P. C. A. show

The S. P. C. A. is generally looked upon by the lay public as a punitive organization. Much work still lies ahead of this body to gain the goodwill of the people. An attempt in this direction has been made by a mofussil branch in Madras.

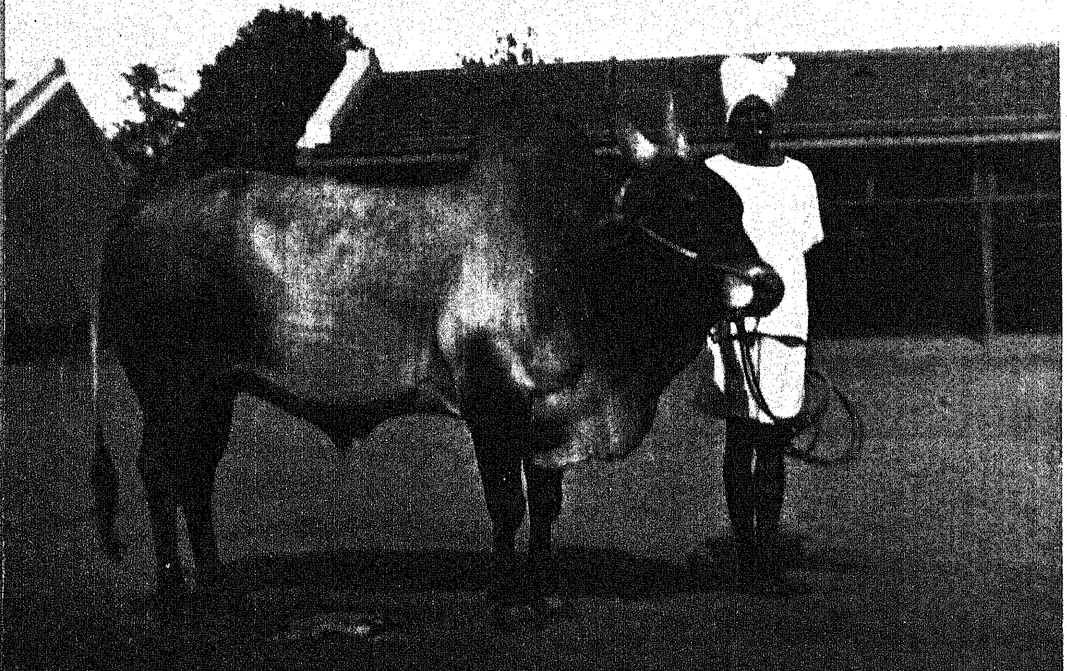
In the deltaic tract of the Cauvery, lies the town of Shiyali in Tanjore district. The local S. P. C. A. organized an animal show on 7 May 1941, taking advantage of an important festival that was in progress then. The Deputy Collector of the Division presided and it was indeed a good show, for a first attempt.

Nearly 600 people gathered and there were 20 pairs of bullocks, 20 dogs, 6 stud bulls and a dozen milch cows with calves, competing for prizes. Great interest was shown by the man in the street. The first prize in each class was a silver cup, the second prize for bullocks was a leather neck strap with bells and the third was a certificate of merit. As remarked by the President, such shows are bound to stimulate care in the breeding, rearing and management of cattle. May we hope other mofussil organizations will follow the good example of Shiyali ?

Winners of the first animal show, Shivali, May 1941



A group of Murrah buffalo-calves at the Hosur Cattle Farm



Kangayam stud bull at the Hosur Cattle Farm

BIHAR

By B. P. AKHAURY, B.Sc. (WALES)
Deputy Director of Agriculture, Patna Range, Patna

EXCEPTING in the hilly tracts of Chota Nagpur, and in the districts of Champaran and Darbhanga, the monsoon was inordinately weak during the months of June and July and it was not until August that satisfactory rains were at all received in the plains of Bihar. These much-needed rains, although they caused local floods in some areas, have improved the general condition of the crop considerably.

Due to the very weak monsoon to start with, the paddy seedlings suffered much and the transplanting of paddy was considerably delayed. A good crop of maize is expected this year except in the Chota Nagpur division where the crop was considerably damaged by heavy and continuous rain. Groundnut is doing well and a good crop is expected.

As the result of the early drought, white ants and borers caused a good deal of damage to the sugarcane crop and in some cases it is estimated that the reduction in yield will be as high as 25 per cent.

Sugarcane

Co 356 sugarcane did not withstand the severe conditions prevailing at all well, and it has shown itself particularly prone to the attacks of insects and disease. It does not seem to be suitable for average village cultivation. Co 313 maintained its popularity with the growers, and it came through the exacting conditions very creditably and at present occupies nearly 60 per cent of the total area in the white sugar belt. Co 299 on the other hand has fallen into disfavour in some parts of Champaran: in the areas of the Harinagar and Bagaha factories it was hopelessly attacked by disease and of late has become susceptible to red-rot and its rejection is advised at present.

The older varieties, Co 210 and Co 213 are fast disappearing while the newer ones Co 356 and Co 513 are being multiplied rapidly. Besides these, Co 393, Co 395 and Co 508, which are undergoing trials in the factory estates, are reported to be doing well. A number of varieties are being tried in South Bihar farms for quick selection of suitable varieties.

Cattle protection

Particular attention was paid to the goat-tissue virus vaccination work which was carried out in actual outbreaks as well as in the villages free from the disease as a precautionary measure. In close cooperation with the officers and workers of the Rural Development Department, the cattle of eight villages were protected against rinderpest by goat-tissue virus vaccination in the absence of an outbreak.

Marketing

From June to August the following grading stations for the different agricultural commodities were in operation :

	June	July	August
Ghee	3	3	5
Ata	1	1	2
Mango	..	1	1
Tobacco	1	..	..
Eggs	1	1	1
Lac	..	1	1
Potato	..	..	4
TOTAL	6	7	14

The grading stations for tobacco, mango, lac and potato were worked as experimental measures.

The three ghee-grading stations were supplemented by two more grading stations in August. These grading stations are working at Darbhanga, Khagaria, Gaya and Patna and 2,121 md. of ghee valued at approximately Rs. 98,120 were graded during the period. The exclusion of Agmark ghee from price control and its exemption from the collection of check samples by the Health Officers under the Food Adulteration Act have given considerable impetus to ghee-grading in this province. On account of the growing

popularity of the graded ghee it is expected that no less than 12 grading stations will be working in the course of a few months.

Four seed-potato grading stations as against only two in the last season are working at Patna and Biharsharif. The three varieties of potato—Lal, Satha and Phulwa—are being graded under three sizes, large, medium and small, at these stations. They started late—in August—and 2,529 md. of potatoes valued at approximately Rs. 18,162 were graded during a fortnight. The graded potatoes are sent mostly to the United Provinces, Bengal and the Punjab. The working of the seed-potato grading stations in the last season showed that the graded seed-potato received a premium of 5·5 per cent over the ungraded.

The seed-lac station was started in July at Jhalda and is functioning under an Analyst-Recorder. So far nine merchants have been authorized to grade and mark their lac at this experimental seed-lac grading station. On account of the speculation in the shellac market and the sharp rise in lac prices grading is making slow progress. So far 924 md. of seed-lac valued at approximately Rs. 43,980 has been graded and sent to Calcutta for shipment.

The four experimental tobacco grading stations had to be closed earlier and only one station at Bhagwanpore worked up to June, where 762 md. of tobacco valued at approximately Rs. 9,156 was graded during the month. The working of the tobacco grading stations in the 1940 season showed that the producers got a premium of not less than 10·3 per cent in price over ungraded tobacco.

Grading ata *at the mills*

Only one *ata* grading station at Patna worked during the period and 42 maunds of *ata* valued at approximately Rs. 241 were graded at this station. The other authorized packer of Dinapore resumed work at the beginning of August, but the station closed soon after. Efforts are being made to start grading of *ata* at the mills to increase the output of graded *ata*. One more merchant at Muzaffarpore has been authorized to grade *ata* under the Agmark scheme.

An important late variety, the Bathua mango in North Bihar, is being graded by the Pusa Mango Marketing Association. This is functioning as an experimental station and so far 94,467 mangoes valued at approximately Rs. 1,785 have been graded and sold. The graded mangoes are despatched to Calcutta and other places. The Senior Marketing Officer, Bengal, looks into the sale of graded mangoes in the Calcutta market. In order to introduce and popularize the graded Bathua mango, a sample parcel of special quality graded mangoes was sent to a foodstuffs contractor for the Ramgarh Camp.

Of the three authorized, only one egg station at Gomoh functioned during the period. The other two stations, one at Barkagaon and the other at Kanke, are expected to start work in the winter.

SIND

By L. M. Hira
Senior Marketing Officer, Sind

SIND is in the grip of the locusts and the menace is assuming a very serious form. The pest is spread over several hundred square miles and is mostly concentrated in the Desert Division of Tharparkar district in the talukas of Mithi, Nagar Parkar and Chachro in the order mentioned.

Other talukas bordering desert areas are also infested and there is every possibility of an invasion of the cultivated areas in the near future, once the swarms begin to move from the desert. The condition of the standing crop is excellent and the prices ruling agricultural commodities are very high. The

total value of the crop is several crores of rupees. The Government is fully alive to the impending calamity and is fighting the menace with all the resources at its disposal. The Director of Agriculture, as also the Collector of the Tharparkar district, are personally supervising the operations and over 200 officials of the Revenue, Agriculture and Public Works Departments are actively assisting them in carrying out the anti-locust campaign in this area. At the peak period of work about a fortnight ago, an army of from seven to eight thousand labourers had been engaged in Thar for destroying the locusts and hoppers. This number has now been reduced to about 4,000 hands.

The locust menace in the province is estimated to cost the Government up to Rs. 3,00,000 and hence the present sanctioned grant of Rs. 2,00,000 is likely to be increased by Rs. 1,00,000.

Establishment of Marketing Board

With a view to giving an impetus to the marketing work in Sind, a Provincial Marketing Board, consisting of six officials and nine non-official members has been set up, with the Director of Agriculture as the chairman and the Senior Marketing Officer as the secretary. Among the non-official members, there are four representatives of the agriculturists, four of the trade and one of the cottage industries.

The chief functions of the Board will be the initiation of investigations into marketing problems of important agricultural crops, the formation of schemes for the improvement of marketing of these crops, for the grading and standardization of produce and generally for the correlation of marketing with agricultural production and with industries allied to agriculture.

The programme of developing marketing facilities includes :

(1) propaganda regarding crop prices, standards, etc.,

(2) provision of godowns and warehousing facilities,

(3) the establishment and development of regulated markets,

(4) cooperative marketing, and

(5) marketing assistance to cottage industries.

Cattle wealth of Sind

What the Guernsey and Jersey cattle are to the British Isles the Sindhi are to India in general and Sind in particular. They are much in demand. The Sindhi cattle stand in a class apart; but the neglect of the most important problem of scientific breeding has caused the fear that attracted by milk, cross-breeding might be resorted to and the pure Sindhi breed might disappear altogether.

In Sind, there are three important breeds of cattle, viz. the Sindhi or Red Karachi, the Tharparkar and the Bhagnari. The first-named of these is essentially a dairy breed, the second is useful both for dairy and draught purposes, and the third is mainly a draught breed. The Sindhi and Tharparkar breeds are found in Lower and East Sind, the former being bred in the hilly tracts near Karachi, and the latter in the desert areas of the Tharparkar district. The Bhagnari breed is a North Sind breed whose home is near the Nari river on the borders of British Baluchistan.

Livestock improvement

In order to stimulate interest in cattle-breeding, and also to accelerate mass improvement of cattle in the countryside, the Livestock Section, which is only two and a half years old, has initiated a widespread campaign for the grading up of the local stock through issue of approved stud bulls. The watchword of the section is: 'Breeding, Feeding and Weeding'. So far over 170 approved bulls have been issued and placed at various centres. The number of services recorded amount to nearly 5,000 and the progeny inspected and earmarked for further breeding comes to about 1,900. These latter are carefully reared for a year or two more on Government and private farms, and then issued to approved zemindars and maldars on the premium bull system.

On the research side, it is proposed to develop the present Willingdon Cattle Farm into a full-fledged livestock research station for taking up work on genetics, nutrition, dairying, disease investigation, etc. The scheme is at present under consideration.

Cattle census

The cattle census of 1939-40 brought to light many interesting facts regarding conditions in the province. According to the census, the total number of cattle in Sind is approximately 2,376,036 of which 593,303 are buffaloes and the remainder oxen. Working bullocks number about 598,734 and cows for breeding and milk production 727,653. The number of bulls used solely for breeding purposes is only 17,557.

A comparison of the figures with the cattle census made in 1935 indicates that the total cattle population in Sind has decreased by about 3 lakhs during the five-year period, 1935-40. A disquieting feature is that the number of bulls used solely for breeding purposes has decreased by 2,000 or 9 per cent in the same period. Recent famine in the desert area was to a certain extent responsible for depletion of the cattle population.

Statistician for Agricultural Department

Dr N. R. Mehta has been appointed to the newly created post of Statistician to the Department of Agriculture in Sind.

Dr Mehta's work will be to lay out all field experiments and work up the statistical results and interpret them, as it is felt to be absolutely necessary that for every experimental result statistical significance must be worked out. It is later proposed that crops should be cultivated on a statistical basis.

A new veterinary hospital built at the cost of over Rs. 12,000 has been opened at Sakrand to train students at the King George the Fifth Agricultural Memorial Institute in the treatment of animal diseases.

BALUCHISTAN

By Nazeer Ahmed Janjua, M.Sc.(Hons.)
Entomologist, Department of Agriculture, Baluchistan

MOST of the fruits in Baluchistan ripen during June, July, August and September. On account of the failure of the rains last winter and due to a severe hailstorm in March, the fruit crop this year was a failure and consequently prices were high.

Of the Californian peaches which had been the subject of study for the past few years at the Fruit Experiment Station, Quetta, the most promising varieties found under local conditions are Babcock, Elberta, Crawford, Phillips, Palora, Sims, Lukens Honey, Champion, Curry, Strawberry, Krummel and Miller's Late. Some of these have been budded this summer on a large scale for distribution among growers. The interesting feature of these Californian varieties is that they have prolonged the local peach season so much so that some varieties like Krummel and Miller's Late ripen in October.

A fairly large number of vines at the Mallezai vineyard planted in 1937 and a few trees at the Murtat Khurd almond grove planted in 1938 came into bearing this season and gave some fruit. It is hoped that next year these orchards, which form a part of our developmental schemes, will be able to give an income to enable the owners to repay the first instalment of their *taccavi* loans.

Commercial fruit products

At the Fruit Products Laboratory, cherries, plums, apricots, grapes and tomatoes were canned on a semi-commercial scale to work out the cost of production, etc. Tomato juice has been prepared on a large scale as there is a large demand for it. Peach squash has also been made and so also some experiments on the drying of potatoes. Grape wine prepared during 1940 was sent for analysis to the Chemical Examiner to the Government of India and the results have been found to be quite satisfactory. It is now proposed to put the wine on the market.

In order to prevent excessive profiteering by middlemen potato seed worth about Rs. 12,000 was distributed by the Agricultural

Fruit Experiment Station, stall at the 'War *mela*' held at Quetta

First progeny of Bhagnari stud bulls displayed at Gumbaz house and Cattle Show, 1941

[PLATE 16

Department to the growers of the Ziarat valley. The seed was sown in April last and the crop is now being harvested. The produce is marketed under the supervision of the Department. During June, July and August about 200,000 eggs have been successfully marketed at Quetta.

Locust invasion expected

Immigrant locusts from countries in the west, e.g. Arabia, Iran, etc. came to Baluchistan, some by about the middle of June and some in the second half of July. Breeding was reported in Kachhi, Jhalawan, Mekran, Marri-Bugti and Las Bela. Hand-picking of the adults and destruction of hoppers by baiting and trenching was done at all the infested places. As a result of control operations, 1,171,268 adults together with millions of hoppers and eggs have been destroyed during the months under report. Reports received from the Locust Warning Organization, New Delhi, however, indicate heavy breeding in Sind and Rajputana and consequently locust invasion is anticipated in North-West Baluchistan during the ensuing winter. Necessary arrangements are being made in the districts of Zhob, Loralai and Sibi to fight the coming menace.

A 'War *mela*' was held at Quetta from 2 to 19 August. The stall of the Agricultural Department was set up where the products of the Fruit Products Laboratory, show-cases depicting the life-history of the important pests and diseases of the province, spraying machines, improved types of implements, etc. were exhibited. Specimens of local fruits available at the time together with new varieties of fruits introduced by the Department were also displayed. Some of the growers who have taken to the fruit products industry under the advice and guidance of the Department also exhibited their products under Agmark labels in our stall. Leaflets issued by the Department were distributed amongst the visitors.

Horse and cattle show revived

The Horse and Cattle Show at Gumbaz (Loralai district), revived in 1940 after a lapse of some 30 years was held this year as well. There were entries of 179 horses, 331 cattle, 24 camels and 61 sheep. As a part of the cattle-breeding scheme which aims at the improvement of the condition of the local cattle, the Civil Veterinary Department, Baluchistan, had given Bhagnari stud bulls to the zemindars and local cattle breeders of Loralai district in April 1940. The first progeny of these bulls was displayed at the show. The Hon'ble the Agent to the Governor-General in Baluchistan gave away the prizes and the show on the whole was a great success.

In order to effect improvement of local sheep the Government of India has sanctioned, from the next financial year, a scheme for the breeding of Bibrik sheep in Hanna Valley near Quetta. The scheme is for six years to begin with and aims at the production of the best white wool. Preliminary arrangements are being made by the Civil Veterinary Department, Baluchistan, for putting the scheme into operation and it is hoped that the province will be greatly benefited by it.

The Month's Clip

MADRAS FISHERIES

THE Fisheries Department in the Province of Madras carried out researches on certain local species of fish at different stations in the province. These included work on marine, estuarine and inland fisheries, pearl and chank fisheries, diving experiments, fish oils, etc.

Marine fisheries

At the West Hill Biological Station plankton investigation was carried out. The plankton was studied with special reference to fish eggs and larvae, decapod crustacean larvae, and sagitta, which were isolated for detailed study. From the quantitative study of plankton it was found that it was at its maximum in September and at its minimum in August. As usual copepods occurred throughout the year and were predominant in the hauls of plankton. Zoo-plankton was more abundant than phyto-plankton. Fish eggs in both the off-shore and in-shore plankton were isolated and studied in great detail. They were found in maximum in September when both clupeoid and non-clupeoid eggs were found in abundance. The identity of three types of fish eggs in the plankton off the West Hill was determined. They belonged to three fishes of economic importance, viz. *Anodontostoma chacunda*, a sardine, *Caranx crumenopthalmus*, a horse mackerel, and *Trichiurus savala*, a ribbon fish.

Sardine and mackerel

It is inferred that during the spawning season the sardine and the horse mackerel seek breeding grounds far away from the shore beyond the fishing zone of the fishermen. The season of ribbon fish extends from June to November. It is also observed that one of the ribbon fishes at any rate, viz. *Trichiurus savala*, shoals for spawning purposes and that it seeks coastal waters during the spawning season which includes September and October. The oil-sardine fishery was more satisfactory this year than last year. It was observed that from the first week of September oil-sardines with fairly developed gonads began to appear off Calicut and continued to be caught regularly until the end of the month. Recovering spents were obtained in the middle of October. The breeding season of sardine off Quilandi was much earlier, viz. from July to the end of September. It was also found that the food of the young oil-sardine does not materially differ from that of the adult sardines. The size of the fish in 1939-40 ranged from 5 to 21 cm. in length overall. Mackerels ranged from 4 to 24 cm. in length overall. An interesting feature of this year's study was the examination of young mackerels, ranging in size from 4 to 7 cm. They appeared in large shoals along with *Stolephorus* (white-bait). Such a collection of young mackerels had not been recorded before. A study of the scales of these mackerels revealed that only specimens 9 cm. or more in length have scales. Specimens smaller in size have no scales. In the European mackerel also the young ones a year old measuring 7·8 cm. are scaleless. It is extremely interesting to note that the stomach of the young mackerels contained *Stolephorus* sp. This observation was unique, as it indicates that young mackerels are carnivorous, whereas the adults are not, their food consisting exclusively of plankton. But this observation requires further study. Additional observations made during 1940-41 prove that fish eggs constitute a normal item of food of the mackerel. Both clupeoid and non-clupeoid eggs were found, but it was not possible to record their characters as they were partly digested. Further investigations may throw light on the question whether the mackerel feeds on the eggs of the oil-sardine.

Sole

Observations on food, size, spawning season and eggs of *Cynoglossus semifasciatus* which is the commonest sole of the West Coast and

yields an important seasonal fishery, have been made from time to time. Specimens ranging from 10 to 13 cm. in length form the bulk of the catches. They attain maturity at about 12 to 14 cm. The spawning season appears to include September and October. There are larger soles consisting of different species of *Cynoglossus*, such as *Cynoglossus dubius*, *Cy. bilineatus*, etc. They occur in small numbers throughout the year and live in the littoral zone preferring muddy bottoms. They range in size from 12 to 40 cm. Unfortunately these large soles do not appear to be gregarious in habit. Unless they occur in shoals, they cannot be got by the hundreds. In addition to the detailed research on oil-sardine and mackerel, ecological studies on other shoaling fishes of the coast such as *Leiognathus bindus*, *Stolephorus*, sp. *Kowala thoracata*, *Caranx crumenopthalmus* and *Arius* spp. were continued. Ear-stones from *Otolithus ruber* of various sizes were collected and ground sections are being made for the study of the concentric lines of growth with reference to the age of the fish.

Food fishes

At the Krusadai Biological Station the identification and study of the local food fishes was continued. A more detailed study of the months in which the common fishes attain maturity was undertaken in order to correlate the fish-eggs in the plankton to the respective parents. Special studies were continued on *Dussumieria hasseltii* and *Lactarius lactarius*. The latter fish begins to shoal from about the end of May when the south-west wind starts and the gonads begin to fill and grow until October when maturity sets in. The males are mostly smaller in size and measure within 18 cm. The females are definitely larger and specimens 25 cm. long occur in the catches. Artificial fertilization was not possible as fish with mature transparent eggs were not common and consequently the identity of the eggs of Lactarius in plankton could not be determined. Lactarius resorts to the open sea beyond the reach of fishermen for spawning. It is a carnivorous fish.

At the Pearl Farm the Japanese model rafts and iron cages are continuing to give satisfaction. The iron cages with corner rivets and stout wire cloth last longer than those without rivets and with thin wire netting. The experiments instituted at the Farm in regard to the artificial inducement of formation of pearls in pearl oysters yielded results which may be regarded as promising, and the experimental work is being continued. During the operations of inducing formation of pearls in oysters in March, the opportunity was availed of to examine the gonads of dissected oysters. The males and females appear to be more or less equal in number. The gonads were found ripe. The oysters were grown in the cubicles for a year and when they were received they were about six to nine months old. It is, therefore, reasonable to infer that the gonads attain maturity when the oysters are 18 months old. The average span of life of the pearl oyster is five years and the sexual function of spawning and the consequent adding to the stock starts when the oyster is 18 months old, and thereafter spawning takes place annually.

Estimating the age of a population of pearl oysters in a given bank is of importance in pearl fisheries. This has been rendered possible by the collection of data regarding rate of growth from pearl oysters successfully reared from the spat stage in the sea off Krusadai for nearly five years. To begin with, the data gathered with regard to the dimensions of the pearl oysters two years old in the farm were subjected to mathematical analysis and the following formulae for ascertaining the age of two-year old pearl oysters were arrived at:

Age and length:

$(1\frac{1}{4} \times \text{length} - 23{\cdot}6) \pm 9 = \text{Age in weeks.}$

Age and weight:

$(1\frac{1}{2} \times \text{weight} + 12\frac{1}{2}) \pm 10 = \text{Age in weeks.}$

Age and length and weight:

$(1\frac{1}{2} \times \text{weight} + \frac{1}{3}\ \text{length} - \frac{1}{4}) \pm 8 = \text{Age in weeks.}$

Sex determination

Determination of sex in *gourami* by means of external characters was studied. It was concluded that the gonad with a frontal knob was found to be a testis and the gonad

without a frontal knob was found to be an ovary. From this it will be possible in future to tell the sex of the adult individuals in a farm and ascertain the proportion of the sexes.

As recent researches in the seas off Great Britain have shown that species of Sagitta (arrow-worms) are indicators of movements of water-masses and, therefore, of fisheries, a detailed study of the occurrence of the various species of Sagitta in Krusadai plankton was undertaken. The work is in progress and it is hoped useful knowledge will be gained by it. Sagitta forms part of the food of *Sardinella gibbosa* and *Dussumieria hasseltii*, two fishes of economic importance in the Pamban area.

Prawn pickling

Technological research was also undertaken at the Tanur Experimental Station. As prawns were abundant during the season the Tanur station took the opportunity to cure large quantities and store them in carbon-dioxide filled tins for supply to customers throughout the year, thereby demonstrating the advantages of carbon dioxide for prolonged storage of cured prawns from one season to another.

Experiments with prawn pickling have shown that the unsightly white flocculent deposit was due entirely to proteins in liquid form not coagulated by the initial blanching. A minimum of ten minutes' blanching before peeling has been found to give satisfactory results. The prawns so peeled were then washed in weak 10 per cent brine and packed. After packing the bottles were exhausted for seven minutes and processed for fifteen minutes at a temperature of 240°F (115°C) and 10 lb. pressure. Experiments repeated during the year under the above conditions, while satisfying every other condition of good preservation, showed a shrinkage in the pickling liquid. In some jars the shrinkage was as much as two-thirds of the original liquid. Further experiments will be conducted with a view to remedying this defect.

Experiments in pilchardizing fish for long storage which were conducted on young, *Sciaena* were extended to mackerel also. The Canadian method of curing and packing pickled fish has been used and the fish pilchardized is still under observation. It has been decided to experiment with costlier fish such as pomfret and seer during the coming season.

Freezing and fumigation

Preliminary freezing experiments have been carried out as a prelude to the transportation of frozen fish in dry ice. There was no deterioration in the condition of the fish and all who tasted the fish remarked on the excellent condition of preservation. The artificial drier was used for drying prawns in inclement weather.

After a series of experiments it has been found that fumigation with half an ounce of carbon bisulphide every four months, or one-eighth ounce every month, is the minimum treatment required per pound of fish to enable salted and sun-dried fish to be stored in good condition for long periods. During the year, experiments were started in order to ascertain whether fumigation with one-eighth or one-sixteenth ounce of carbon bisulphide every month will preserve two or three pounds of fish in the same jar, thereby reducing the cost of the chemical per pound of fish. Silver bellies, young *Sciaena* and young cat-fish were chosen for the experiment. One-eighth ounce of carbon bisulphide was used every month in one jar and one-sixteenth ounce every month in another and a third jar was kept as control. The condition of the fish has been satisfactory. The experiment is being continued.

Shark-liver oil

Researches on certain local species of fish are being conducted with a view to determining the vitamin A content of their liver oils and the results so far obtained show that the oils derived from different species of sharks have got very high vitamin A potency, i.e. ten to fifteen times as much as average cod-liver oil. The question of the production and supply of shark-liver oil has assumed considerable importance at the present time, because the cod-liver oil which used to be imported from the Scandinavian countries to

meet the requirements of the army as well as of the hospitals for the treatment of vitamin A deficiency is not available owing to war conditions. As a consequence of the increased demand for fish-liver oils, large quantities of oil from shark-liver are produced and it is hoped that a regular industry might be set up to meet the requirement. From the samples assayed for vitamin A at the Nutrition Research Laboratories, Coonoor, it has been found that on the average, shark-liver oil contains about 10,000 international units of vitamin A per gramme, i.e. 10 to 15 times as much as average cod-liver oil. Some samples were even richer than this. A sample oil of the shark *Carcharinus gangeticus* tested in June 1940 was found to contain about 97,500 international units of vitamin A per gramme. Another shark which gives a rich oil is the saw-fish (*Pristis*). The average value of a number of samples was found to be 12,000 international units per gramme. Although the vitamin A content of shark-liver oil shows variations which are probably dependent on species, sex, season etc., it has been established beyond doubt that shark-liver oil in general is a most potent source of vitamin A. As cod-liver oil can no longer be imported in any quantity, an opportunity is thereby provided for developing an indigenous industry for the production of fish-liver oil rich in vitamin A and also for manufacturing malt extracts and emulsions and various preparations of this kind.

The Department of Fisheries have, in connection with the scheme for initiating the fish-liver oil industry in the coastal villages of the Presidency, issued a leaflet describing a simple method of extracting the oil from the liver of oil-yielding fishes with high vitamin A potency. As a result of this drive oil was manufactured at 24 yards on the West Coast and 10 yards on the East Coast. The total quantity of oil extracted from December 1939 to May 1940 was 315 gallons on the West Coast and 84 gallons on the East Coast. Since the close of the year steps have been taken to encourage the fishermen to catch more sharks and to stimulate the flow of livers into the fish yards, whilst a blending and dilution station has been organized at Calicut with a view to producing the much-needed liver-oil in quantity.

The experiment with the anti-oxident (maleic acid) is being continued and the effects of using different containers—white and brown glass bottles and white flint glass bottles—for storing the oil during the experiment are being watched.

Sea-weed as manure

The treatment of diseased and dying coconut trees at the Tanur Station with sea-weed manure has shown good results. The leaves are no longer yellow but are of a dark-green, healthy colour and the trees have started to bear. Apparently the mixture of one to four of weed and ash is the best and should be adopted in all cases. Six other trees in a weak and unhealthy condition have been treated with raw sea-weed and sheep manure and they are under observation.

Inland fisheries

Experiments in deep-water fishing were conducted during the year and the use of the following nets were demonstrated :

(i) Gill nets (with burnt clay weights and floats),
(ii) Drift nets (without weights),
(iii) Drift nets (hemp nets without weights—big-meshed), and
(iv) Encircling net (at a depth of 20 ft.).

In all these experiments the absence of a suitable motor boat with greater carrying capacity and speed than the one now available was a handicap.

A scheme with the bare minimum of staff and expenditure for the popularization of *Gourami* fish in the rural areas of the province is under consideration.

Gourami continued to thrive and breed well at the Sunkesula Fish Farm. At the Ippur Fish Farm experiments on the breeding of this valuable fish were successfully carried out, confirming the suspicion that the factor which had been operating adversely was not so much the alleged salinity of soil and water in the farm as the over-abundance of predaceous fish and other animals such as murrels, fresh-water eels, cat fishes, frogs, snakes, etc. With a view to determining the cause beyond

the possibility of doubt, the experimental pond provided with a ferro-concrete slab enclosure was thoroughly drained, silt cleared and predaceous animals, of which there were plenty, eradicated. *Gourami* were reintroduced into the pond on 1 February 1940. On 29 February 1940, i.e. 28 days after their introduction, newly hatched out tiny fry were noticed in nests built by the *gourami*, proving conclusively that the presence in abundance of predaceous enemies was the main reason for the continued failure of the *gourami* breeding hitherto. With a view to extending the distribution of this valuable exotic fish, hitherto cultured exclusively in controlled fish farms, to other water areas in the province and thereby making it available for the public, besides augmenting the fish food supply, the fingerlings of *gourami* were for the first time introduced into the waters at several places such as the Mettur reservoir, the Mopad reservoir, etc.

Etroplus is thriving well and breeding prolifically in all the fish farms and the use of its fry in stocking the various provincialized waters is being continued. With the extension of the Cuddapah-slab facilities essential for the breeding of this fish, there was a marked increase in the output of fry for stocking the provincialized tanks.

Acclimatization of mullet

Fry of all available species of mullets were experimented upon in regard to their susceptibility to acclimatization in fresh waters. One species of *Mugil cephalus* has been found to be most suitable and easily available in the neighbourhood of Ippur.

Chanos chanos—milk fish—is a valuable estuarine fish which thrives well in fresh water. An attempt was made during the year to rear this fish in the Ippur fish farm. If, as is expected, the experiment proves a success, it will be extended to other waters. In the Philippines, where the fish is known as 'bangos', it is very extensively cultivated and the fishery is worth several million dollars. Experiments conducted have shown that this fish grows fairly well and fingerlings measuring 2 in. to $3\frac{1}{2}$ in. attained a size of 13 in. in a period of 14 months.

The experiments conducted at the Sunkesula Fish Farm have enabled valuable data to be gathered on the rate of growth of *gourami*. It is clear from the results that the rate of growth of the fish up to 5·4 in. is nearly 50 per cent more rapid than the rate of growth from that size to 10·6 inches. The rate of mortality, however, varies more or less with the size of the fish, the larger the size the lower the percentage of mortality. For a more accurate determination of the rates of growth and mortality, it is proposed to start experiments with more or less uniform sized fry in order to ascertain the mortality and growth at intervals of six months. Experiments to determine the effect of weeds common in Kurnool district on the growth of fish are carried out at the farm at Sunkesula.

An examination of the *p*H records has shown that the *p*H varies according to the fish contents and that it is a fairly safe guide to detect a crowded condition of any pond. The *p*H range best suited for fish life has been ascertained to be 6·5 to 8·5. The importance of recording temperature and *p*H value of water in the fish farms has been brought home to the officers concerned.

Diving experiments with the high pressure air compressor were conducted and the results were satisfactory.

Oyster shell grit

The by-product, oyster shell grit, obtained at the Ennur Zoological Supply Station is becoming increasingly popular with poultry farmers. About 6,000 lb. of shell grit were manufactured and sold during the period under review as against 4,217 lb. the previous year.

Anti-malarial work was as usual carried out by stocking waters heavily with larvicides in order to prevent mosquito nuisance by the supply of larvicidal fish to those requiring them and by advising the local bodies with regard to the availability of larvicidal fish for stocking their waters.

The work in connection with the collection and identification of specimens of marketable fishes from various parts of the province and the compilation of statistics is proceeding. After all the specimens collected from

the villages have been identified and an exhaustive list in all the vernaculars with corresponding scientific names prepared, the drafting of the report will be taken up. Leaflets on *Osphromenus gourami*, *Etroplus suratensis*, and *Catla catla* were revised and reprinted during the year.—*Madras Fisheries Department Administration Report for 1939-40.*

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DECLINE IN AMERICAN AGRICULTURE

THERE is a general disposition, in America as well as abroad, to think of the United States as primarily an agricultural country. The 1940 census is a reminder that, not only is this no longer true, but it has not been true for a generation. The general structure of America is profoundly altered from that of, say, 1914, as illustrated by the census of 1910.

In 1910, the population was a little over 90 millions, of whom 50 millions were classed as rural—that is, living on farms or in communities of under 2,500. In 1940, the total population had passed 130 millions, of whom less than 60 millions were rural and over 70 millions were urban. That is, in these thirty years, the total population had grown by 40 millions, but over three-fourths of this increase was in urban communities.

Politically speaking, the balance of power has definitely shifted from the country to the city. In the south, and in the sparsely settled States of the west, the majority of the population is still rural; elsewhere, in most States, the majority of the population is urban. In 1930, some twenty-nine States classed a majority of their populations as rural, and these States would have contributed fifty-eight of the ninety-six senators. The 1940 data are not yet published, but would not have altered this fact materially. But as these are States of small population, the great majority of the members of the House represent city constituencies. In 1910, both Houses decidedly represented rural constituencies.

By no means all the rural population is concerned with farming; on the other hand, the smaller urban communities are directly dependent on farming. The census distribution is, therefore, not entirely indicative of agricultural interest. As to the farms themselves, the census of 1940 counted 6,096,789 farms, a decline of 200,000 farms for the decade. The acreage in farms, however, increased from 987 millions to 1,061 millions. This gives an average of 177 acres per farm, and, with all the variations in local conditions, it is surprising that the majority of farms run so near the average. In the east, the typical farm runs nearer 100 acres, and further west nearer 200 acres. At the extremes are the truck farms and the ranches.

Drop in farm values

The value of all farm land and buildings was given as $34,000 millions in 1940, compared with $48,000 millions in 1930, a decline of nearly 30 per cent. In 1920, the value was given as $66,000 millions, or almost $70 an acre. The 1940 value was something over $30 an acre. In 1940, farm buildings were valued at $10,000 millions, and implements at $3,000 millions.

On these farms, about one-third (322 million acres) were under crops; another third was under pasture, fallow and woodland; and the final third was unspecified.

The general problems of American agriculture are not the problems of an export surplus. The 'export surplus' problem is concentrated in a few crops—wheat, cotton and tobacco. These are localized and politically expressive; nor is their solution obvious. Much of the wheat is grown on land that will produce no other marketable crop; it could be converted into grazing, but not readily in the unit sizes in which it is held. Most of the cotton land is capable of other uses, but its conversion would require a complete change of local habits.

The agricultural problem, which, as can be seen, cut the value of farms in two between the boom of 1920 and the early depression of 1930, and which, in spite of an urban recovery, had taken another 30 per cent of the value between 1930 and 1940, is essentially a domestic problem. As yet, the farmer has got almost nothing out of the war boom that has restored to the urban worker conditions equal to or exceeding those of the New Era.—*The Economist*, 29 March 1941.

New Books and Reviews

Report on the Marketing of Milk in India and Burma

By THE AGRICULTURAL MARKETING ADVISER TO THE GOVERNMENT OF INDIA (Manager of Publications, Delhi, 1940, pp. 304, Re. 1-4)

THE contents of this publication are included under eight chapter headings dealing with supply; utilization and demand; prices; collection, treatment and distribution; transportation; cooperative marketing of milk; quality of market milk; and reorganization of milk marketing. These headings indicate the comprehensive nature of the report. One very useful character of this report is a special arrangement to which the attention of the general reader is directed. This includes a series of inter-chapters, numbering eight in all, in addition to the section of conclusion and recommendations. As is indicated in the introduction, a quick grasp of this report can be obtained by reading only these inter-chapters. This should prove extremely useful to those not particularly interested in the extreme detail found in the body of the report. It might be suggested that an article of the same title as this bulletin might be made up of these inter-chapters and published in some widely circulating periodical read by the Indian public. This would bring the report to the attention of a far larger number of producers and consumers of milk in India. It would thereby enhance the usefulness of the publication which has involved so much careful effort on the part of the Agricultural Marketing Adviser and his staff.

Unfortunately the 1940 cattle census was not available at the time this publication was prepared. Aside, however, from some of the figures, as to the numbers of cattle, buffaloes and goats, having reference to a period of some years ago, the method of treating various problems is very useful. For example, the chapter on the supply of milk has seven main sub-heads in each of which there are up to twelve separate divisions, which may be further divided in some cases. The number of milk animals is considered as follows: the number of cows, the number of she-buffaloes, the number of goats, sheep, asses and camels and the number of cattle in India and Burma in comparison with the world's total cattle population.

Inter-chapter one, a brief summary of the entire chapter dealing with supply, indicates that India had 230 million cows and buffaloes in 1935, which constituted approximately one-third of all cattle and buffaloes in the world. However, the milk production at that time was estimated to be only one-fifth of the milk produced in all of Europe including Russia. The number of large herds in India is very small; cows and buffaloes usually being kept in groups of two or three by individual *gowallas*. It is noted also that whereas she-buffaloes in Kathiawar produce as much as 2,500 lb. of milk a year, the average for India is 1,270 lb. The average yield per cow of hand-drawn milk, e.g. milk obtained by hand in excess of that consumed by suckling calves which is estimated at 300 lb. is only 525 lb. About goats the report says: 'The average milking goat gives 170 lb. of milk per annum and the kid consumes about 50 lb. The total milk available is approximately six ounces *per capita* for the human population of India and Burma. This figure compares very unfavourably with 40·7 ounces daily per person in great Britain, 56·8 ounces daily per person in Canada, 44·2 ounces daily per person in the Netherlands and 44·4 ounces daily per person in Australia.'

A large portion of the Report is devoted to the question of methods of collection, quality and transportation. Numerous illustrations are included to show the various methods of handling and distributing milk. Whatever container is popular in the various areas of India for the handling of liquids is used as well for the handling of milk. Very little modification has been made in any of these containers. Occasionally, it is indi-

cated, a lid has been devised, although more often the vessel is closed with leaves or grass or not closed at all. Improved types of milk cans are being made in India, however, which are a great contribution to the quality and transportation of milk. The report indicates that insufficient attention has been given in the country as a whole to the question of speedy transportation of milk and the effect of the time which elapses between production and consumption on the quality of milk. Various suggestions are included to meet such problems. The processing of milk is discussed briefly.

Finally, the last chapter, as has been indicated, is devoted to the questions that arise and which must be dealt with in reorganizing the milk marketing practices that prevail. The principles upon which suggestions of this type are made are strictly cooperative, although the need of certain types of legislation which are also indicated is emphasized. Legislation, which is actually executed, is necessary to facilitate the satisfactory operation of any system of milk distribution, if the quality of the product is to be maintained. Nothing destroys the quality of milk quicker than extended exposure to the Indian climate and to the dust and dirt of our city streets, especially if the milk is contained in porous containers, such as wood or earthenware, which are not properly cleaned before the milk is placed in them. Unfortunately, laws which already exist are not enforced, as indicated by the fact that adulteration has been found in every part of India to occur in as many as 30 to 50 per cent of the samples, whereas the report indicates that fines on milk cases generally range from Rs. 2 to Rs. 20 and 'Not a single case has been, however, reported in the entire history of the working of the Food Adulteration Acts in India in which a milkman has ever been imprisoned for adulterating milk.'

A few questions could be asked about the accuracy of certain statements made in the publication, but fortunately very few. The outstanding one noticed by the reviewer is on page 48 where it is said, compared with the fat content of the milk of European and American cows, the milk of Indian cows is richer by about 50 per cent. If Indian cow's milk contains 4·5 to 5·5 per cent butter fat, as indicated on page 17, the above statement would imply that cow's milk in western countries tests from 3·0 to 3·6 per cent butter fat, whereas 4·0 per cent is much more accurate.

The report is very comprehensive and might be found useful as a text book in our agricultural colleges and as a work of reference for all who are interested in the numerous aspects of the Indian milk problem and India's difficulties of properly feeding her human population.—(J. N. W.)

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Science in War

(Allen Lane, Penguin Books, pp. 144. Second edition, 1940, 8 as.)

SCIENCE in War is the first Penguin book to be issued anonymously. It has been written by 25 scientists, all of whom are authorities in their own subjects. The main object of the book is to analyse the conditions which lead to a dangerous state of affairs by the half-hearted use of science in war effort and to indicate boldly that the full use of our scientific resources is essential for our ultimate victory. The generous reception given to the book shows that it has achieved its object, viz. a wide realization that it is vitally necessary today to make the best use of our scientific knowledge. The book is divided into eight chapters which provide a series of pictures of the different directions in which science—both in research and application—affects the most urgent problems of the war.

It has been shown that scientific knowledge is of immediate and decisive importance to the present struggle and that the main issue of the war, and the nature of the peace that will follow will largely depend on how effectively and quickly scientific ideas can be utilized. While the whole book is interesting and instructive, some of the chapters are fascinating. Thus chapter II deals with some of the achievements of modern science, viz. the production of substitutes, like synthetic nitrates and substitute oil fuels, the virtual abolition of the enteric fevers among troops and the evolution of the aeroplane. Chapter

III deals with science in the conduct of war and gives a mass of useful information on tanks, camouflage and other matters. Chapters IV and V deal with war wounds and their treatment and food problems. This little book is of immense value at the present time and the following extract from the preface to the second edition is a great tribute to its importance and usefulness :

'Since the first appearance of the book some favourable changes have taken place in the use of our scientific resources, and the effective realization of a few of the practical suggestions which the book advances suggests that many of the ideas expressed by the authors of *Science in War* have also been exercising opinion in authoritative and executive quarters.'—(S. C. R.)

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Indian Sugar Manual

(THE SUGAR TECHNOLOGISTS' ASSOCIATION OF INDIA, CAWNPORE, 1941, pp. 338, Rs. 6)

A REVIEW of the 1940 issue of the *Indian Sugar Manual* appeared in the August number of this magazine. We have now received the 1941 edition, compiled on the same broad lines, and with the chapter on sugar in foreign countries somewhat amplified. The manual is expected to be an annual feature of the activities of the Sugar Technologists' Association.